The phonology of pitch accents in Chickasaw[*]

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1 Introduction

While the theoretical literature is rife with typologically oriented analyses of stress, (e.g. Liberman and Prince 1977, Prince 1983, Hayes 1980, 1995, Halle and Vergnaud 1987, Crowhurst and Hewitt 1994, Kenstowicz 1997, Walker 1997, Eisner 1997, Bakovic 1998, Elenbaas and Kager 1999), the interaction between word-level and phrase-level prominence has been the subject of relatively little typological investigation by phonologists. This failure to differentiate word-level and phrase-level prominence largely stems from the paucity of explicit descriptions of contextual stress variation and, more generally, from the dearth of data on intonation, which is closely linked to the expression of phrase-level prominence. Most primary sources report stress patterns for individual words without indicating the context in which the words were elicited, though it is likely that in many, if not most, cases they reflect isolation forms. There are few detailed comparisons of phrase-level and word-level prominence (see, however, work on phrasal prominence by Pierrehumbert 1980, Ladd 1983, Hayes and Lahiri 1991, Truckenbrodt 1995, Kahnemuyipour 2003). Based on the available data, however, certain recurring interactions between word-level and phrase-level prominence, as diagnosed through intonational phenomena, have been identified. For example, prominence is typically projected from the word-level on up to higher prosodic constituents such that certain syllables with word-level stress carry phrasal prominence through their association with pitch accents (see, for example, Pierrehumbert 1980 on English, Ladd 1983 on Hungarian, Hayes and Lahiri 1991 on Bengali). It is unclear, however, given the small sample size of languages with thoroughly described prominence systems, whether the relationship between word-level stress and phrase-level prominence found in well-documented languages is cross-linguistically common or not.

This paper describes a language, Chickasaw, in which constraints sensitive to phrase-level pitch accents outrank certain word-level metrical constraints. The result of this interaction is an asymmetry between stress patterns found in phrase-final words, where pitch accent constraints are relevant, and words uttered in non-final position, where word-level metrical constraints

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function unperturbed by pitch accents. Words in Chickasaw display up to three different stress patterns depending on their location in a phrase and, in the case of phrase-final words, the semantic properties of the phrase. For example, the word /aːʃoppalaʔ/ 'light, lamp' has primary stress on the initial syllable in phrase-non-final position, i.e. [ˈaːˌʃoppaˌlaʔ], on the final syllable in final position of statements, i.e. [ˌaːˌʃoppaˈlaʔ], and on the antepenult in final position of questions, i.e. [ˌaːˈʃoppaˌlaʔ].

In brief, the primary stress on the initial syllable in the phrase-non-final instantiation results from a peak prominence constraint (Prince and Smolensky 1993, Kenstowicz 1997) requiring that a long vowel carries primary stress in a word. Phrase-finally, word-level stress constraints compete with phrase-level pitch accent constraints to produce both "top-down" and "bottom-up" prominence assignment. Relevant for all phrase-final forms is an inviolable constraint ensuring that the primary stress of the phrase, and thus the word containing the phrasal stress, coincides with the pitch accent. In statements, the stress on the ultima results from a constraint requiring alignment of the pitch accent with the right edge of a phrase being ranked above the word-level stress constraint attracting stress to long vowels, an instantiation of "top-down" stress assignment. The stress on the antepenult in a question-final word is attributed to an anti-tonal crowding constraint, which forces the high-toned pitch accent leftward away from the final low boundary tone characteristic of questions (but not statements). The docking of the pitch accent on the heavy antepenult in question-final words rather than the light penult is attributed to a word-level anti-clash constraint: if the penult carried the pitch accent (and thus stress), this would create a two-sided stressed clash between the penult and both the antepenult, stressed due to its heavy closed syllable, and the ultima, stressed by virtue of being word-final. The relevance of clash for pitch accent placement is important since it means that "bottom-up" prominence assignment exists alongside "top-down" prominence assignment.

A further complication concerns the role of morphology in pitch accent placement. Word-level stress is largely blind to morphology whereas pitch accents display different degrees of attraction to prefixes, roots, and suffixes. Prefixes systematically reject the pitch accent, while suffixes attract the pitch accent away from the root. The relevance of morphology to phrase-level pitch accentology, a violation of bracket erasure conventions, falls out from a combination of prosodic and morphologically-informed constraints on pitch accent placement interleaved with other pitch accent and word-level stress constraints.

The goals of this paper are twofold. First, the work seeks to broaden our typological understanding of interactions between word-level and phrase-level prominence through careful empirical examination of such interactions in a single language. Second, the paper proposes to show how Chickasaw instantiates a system expected to exist in an Optimality-theoretic (Prince and Smolensky 1993) analysis of prominence employing word-level metrical constraints and phrase-level pitch accent constraints. Different ranking permutations of these word-level and phrase-level constraints yield both bottom-up and top-down prominence in Chickasaw.

The structure of the paper is as follows. Section 2 analyses word-level stress. Section 3 analyzes cases in which word-level metrical constraints and phrase-level pitch accent constraints do not conflict with each other to produce positional stress asymmetries. Cases of top-down prominence in which highly ranked pitch accent constraints override word-level metrical constraints are discussed in section 4. Section 5 discusses interactions between morphology and pitch accents in Chickasaw. Finally, section 6 summarizes the results of the paper.

2 Chickasaw stress

Chickasaw is a Muskogean language spoken by at most a few hundred speakers in south-central Oklahoma. Word-level stress in Chickasaw in Chickasaw is phonologically predictable. It falls on the final syllable of a word, on heavy syllables (CVV and CVC), and on the second in a sequence of light (CV) syllables. A stressed vowel in a non-final CV syllable is rhythmically lengthened (Munro and Ulrich 1984, Munro and Willmond 1994, Munro 1996, Gordon et al. 2000). For example, the even-numbered non-final vowels in /tʃipisalitok/ 'I looked at you' and /pisalitok/ 'I looked at her/him' are lengthened, i.e. [tʃiˌpiːsaˈliːˌtok] and [piˈsaːliˌtok]. Rhythmic lengthening is suppressed in final syllables, e.g. [tʃiˈpiːsaˌli] not *[tʃiˌpiːsaˈliː] 'I look at you'. Rhythmic lengthening is also observed in many other languages with iambic type stress patterns (see Hayes 1995, Buckley 1998 for an overview), including Yupik (Jacobson 1985, Miyaoka 1985, Woodbury 1987), Kashaya (Buckley 1994), and Choctaw (Munro and Ulrich 1984), Chickasaw's closest linguistic relative.

Primary stress is sensitive to a distinction between word-level stress and prominence at the level of the Intonational Phrase (see section 3). Word-level stress patterns surface in words that are not in final position of an Intonation Phrase. In IP-non-final words, the final syllable carries primary stress in words lacking either a long or rhythmically lengthened vowel. In words containing a single long (or lengthened vowel), henceforth CVV, the primary stress falls on the long/lengthened vowel. In words containing multiple CVV syllables, there is variation, both inter and intraspeaker, in whether the rightmost or leftmost CVV carries primary stress. Most commonly, the rightmost CVV receives primary stress and the others receive secondary stress. Words illustrating word-level, i.e. IP-non-final, stress appear in (1).

(1)

ˌissoˈba	'horse'
ˌbaʃˈpo	'knife'
ˌbakʃiˈjaːˌmaʔ	'diaper'
aˈboːkoˌʃiʔ	'river'
ˈbaːˌtamˌbiʔ	name
ˈʃiːˌki	'buzzard'
oˈfõːˌlo	'screech owl'
tʃaˌlakˈkiʔ	'Cherokee'
ˌokˌfokˈkol	'type of snail'
ˈnaːɬtoˌkaʔ	'policeman'
piˈsaːliˌtok	'I looked at him/her'
ˈaːˌtʃomˌpaʔ	'store'
tʃiˌpiːsaˈliːˌtok (or tʃiˈpiːsaˌliːˌtok)	'I looked at you'
ˌaːjoˈkaːˌtʃiʔ (or ˈaːjoˌkaːˌtʃiʔ)	'police station'
ˌaːkiˈlaːʔ (or ˈaːkiˌlaːʔ)	'wick'
taˌʔosˌsaːˌʃaːˈtʃa-ːt (or taˌʔosˈsaːˌʃaːˌtʃa-ːt)	'bank' (subj)
ˌnaːfˌkaːˈpaːkoˌtaʔɬˌtʃiʔ (or ˈnaːfˌkaːˌpaːkoˌtaʔɬˌtʃiʔ)	'hem'

Syllables carrying different degrees of stress are differentiated phonetically: the greater the level of stress, the greater the duration and intensity of vowels, and the higher the fundamental frequency. Speakers differ, however, in the degree to which they rely on various cues to stress with duration and f0 being slightly more reliable correlates of stress than intensity, particularly to the primary vs. secondary stress distinction. Table 1 summarizes values from Gordon (2002a) (averaged over 8 speakers; 5 female and 3 male) for duration, intensity, and f0 for vowels associated with different degrees of stress in Chickasaw. The measurements are drawn from a list of 83 words representing several different word shapes elicited in IP-non-final position. Intensity and f0 values are averaged over short and long vowels with differing degrees of stress, while long vowels are excluded from the duration measurements due to their inherently greater length relative to short vowels.

Table 1. Duration, F0, and Intensity values for vowels associated with different levels of stress (averaged over 8 speakers; standard deviations in parentheses)

	Duration (msec)	F0 (Hz)	Intensity (dB)
Primary	87 (24)	187 (43)	77.4 (5.7)
Secondary	76 (17)	180 (41)	75.8 (5.9)
Unstressed	58 (21)	159 (39)	74.9 (5.9)

All pairwise differences between different levels of stress within an acoustic dimension are significant at minimally $p<.05$ according to unpaired t-tests except for the intensity difference between secondary stressed and unstressed vowels. In addition to duration, intensity, and f0, vowel quality also differs as a function of level of stress, with unstressed vowels undergoing centralization relative to stressed (both primary and secondary stressed) vowels. There are also lenition processes affecting unstressed vowels. These include a number of syncope processes target stressless vowels in certain contexts (see Munro and Ulrich 1984, Munro and Willmond 1994, Munro 1996 for discussion), as well as a process of devoicing targeting unstressed vowels between voiceless consonants or word-initially before a voiceless consonant.

2.1 Morphological factors in stress and rhythmic lengthening

Word-level primary stress is largely blind to morphology, as prefixes and most suffixes attract or reject stress accordingly to purely phonological factors. For example, the 2sg. alienable possessor prefix /tʃĩː-/ attracts primary stress in ˈtʃĩːˌsinˌtiʔ ‘your snake’, since it is the only CVV in the word. Similarly, the locative prefix /aː-/ has main stress in ˈaːˌtʃomˌpaʔ ‘store (i.e. place for purchasing)’ and the object suffix /-ãː/ attracts primary stress in koˌniˈãː ‘skunk (object)’. Conversely, the 1sg. inalienable possessor prefix /sa-/ lacks stress in saˌtʃonˈkaʃ ‘my heart’ and the 1sg. subject suffix /-li/ is unstressed in piˈsaːliˌtok ‘I looked at her/him’.

Unlike primary stress, secondary stress and rhythmic lengthening are sensitive to certain morpheme boundaries but not others (see Munro and Willmond 1994 for discussion of morphological factors in rhythmic lengthening). Crucially for present purposes, certain prefixes fall outside the domain of rhythmic lengthening and secondary stress assignment comprising the root. For example, the 2sg. dative/possessive prefix /tʃim-/ has secondary stress and does not trigger rhythmic lengthening of the first vowel of a vowel-initial root: ˌtʃimaˈpiːˌla *tʃiˈmaːpiˌla ‘S/he helps her/him for you’, ˌtʃimaˌkanˈkaʔ *tʃiˈmaːˌkanˌkaʔ ‘your chicken’. The blocking of rhythmic stress assignment and the non-application of lengthening across these prefix-root boundaries will be shown in section 5.1 to correlate with the rejection of the pitch accent by these same prefixes.[1] The blocking of rhythmic stress and lengthening across these prefix boundaries suggests an intervening prosodic boundary. I will term the domain separated by this boundary the “prosodic word”. The prosodic word is smaller than the domain of primary stress, which is co-extensive with the entire morphological word. I will call this larger domain the “minor phrase”.[2]

Further evidence for the prosodic word as a domain smaller than the morphological word comes from compounds. Rhythmic lengthening is typically blocked across roots forming compounds and the final syllable of each member of the compound is stressed: {aˌkanˌk}{ˌoʃ}{aˈpaʔ} *{aˌkank}{oʃ}{ˈaːˌpaʔ} ‘chicken snake’ (=akankaʔ ‘chicken’ + oʃiʔ ‘baby’ + apaʔ ‘eater’).[3] The blocking of rhythmic lengthening and stress across boundaries within a compound follows if one assumes that each root forms an independent prosodic word and that all the roots in the compound together form one minor prosodic phrase over which primary stress is calculated: {baˈlaːfˌkaʔ}{toˌbaʔ} ‘denim’ (balaːfkaʔ ‘pants’ + tobaʔ ‘step relation’).

Certain suffixes belong to the same rhythmic stress and lengthening domain as the root, while others do not. Crucially, the suffixes that will be shown in section 5.2 to obligatorily carry a pitch accent also are part of the same rhythmic stress and lengthening domain as the root. For example, the sequence of the 1sg. subject suffix /-li/ (as a target) and the remote past suffix /-toːk/ (as a trigger) is part of the rhythmic stress and lengthening domain in ˌmalliˌliːˈtoːk *ˌmalliliˈtoːk ‘I jumped (distant past)’. Thus, rhythmic lengthening does not provide evidence for a prosodic boundary between the root and suffixes that attract the pitch accent. For this reason, the attraction of the pitch accent by suffixes will be claimed in section 5.2 to follow from a morphologically-informed constraint on pitch accent placement.

2.2 A constraint-based analysis of word-level stress

In order to develop a formal analysis of pitch accents and their interaction with word-level stress it is necessary to provide an OT analysis of word-level stress as background. The constraints adopted to account for word-level stress draw on constraints previously proposed in the phonology literature and follow Gordon (2002b) in referring directly to stress rather than feet.[4]

Chickasaw basically observes an alternating stress pattern, captured through a combination of the rhythmic constraints, *CLASH and *LAPSE, originally codified as metrical well-formedness principles in a derivational framework by Prince (1983) and Selkirk (1984) and since adopted in numerous OT analyses of stress (e.g. Green and Kenstowicz 1996, Elenbaas and Kager 1999,

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[1] Not all prefixes fall outside of the prosodic word containing the root; the transitive object/stative subject and reciprocal prefixes belong to the same prosodic word as the root. These prefixes are either monosyllabic or disyllabic of the form heavy plus light syllable and thus trigger lengthening in the first vowel of the root: e.g. po{piːsa} ‘S/he looks at us’, sa{hoːjo} ‘S/he looks for me’, tʃi{piːsa} ‘S/he looks at you’, itti{piːsa} ‘They look at each other’.

[2] I use the designation minor phrase to distinguish the domain of primary stress from the Accentual Phrase, which is the domain of phrasal tone assignment and which may comprise multiple morphological words (see Gordon 1999, to appear for discussion).

[3] Certain compounds have the option as being realized as a single prosodic word, in which case, as expected, rhythmic lengthening and stress applies to the second vowel in a CVCV sequence across roots forming the prosodic word, e.g. {ˌissoˈb**oː**ˌʃiʔ} ‘colt’ or {ˌisˌsob}{**o**ˈʃiʔ} (issoba ‘horse’ + oʃiʔ ‘baby’).

[4] Gordon (2002b) shows that a grid-based theory of stress offers a closer fit to the typology of stress than foot-based metrical theories.

Gordon 2002b). For present purposes, a simple version of the two constraints is adopted. *LAPSE bans adjacent unstressed syllables and *CLASH bans adjacent stressed syllables.

(2) *LAPSE: A string of more than one consecutive unstressed syllables may not occur.
(3) *CLASH: A string or more than one consecutive stressed syllables may not occur.

*LAPSE is not violated in Chickasaw and crucially outranks an alignment constraint (McCarthy and Prince 1993) requiring that stressed syllables be aligned with the right edge of a word: ALIGN (σ́, R, PrWd) (4).[5]

(4) ALIGN (σ́, R, PrWd): A stressed syllable is aligned with the right edge of a prosodic word.

Stresses placed to honor *LAPSE potentially lead to further violations of ALIGN (σ́, R, PrWd) (5).

(5)

tʃipisa 'S/he looks at you'	*LAPSE	ALIGN (σ́, R, PrWd)
☞ tʃiˈpiːˌsa		*
tʃipiˌsa	*!	

*CLASH is ranked below ALIGN (σ́, R, PrWd), as stress falls on the second syllable rather than the first in an initial sequence of light syllables even if the third syllable is stressed (6).

(6)

pisatok 'S/he looked at her/him'	ALIGN (σ́, R, PrWd)	*CLASH
☞ piˈsaːˌtok	*	*
ˈpiːsaˌtok	**!	

Following Gordon (2002), the constraint responsible for final stress is a constraint requiring that word edges, i.e. the first and last syllable of a prosodic word, be aligned with stressed syllables: ALIGN EDGES (σ́) (7).

(7) ALIGN EDGES (σ́): Both edges of a prosodic word are aligned with a stressed syllable.[6]

One violation of ALIGN EDGES (σ́) is incurred if either the initial or final syllable is unstressed and two violations are incurred if both the initial and final syllable are unstressed. ALIGN EDGES (σ́) is outranked by ALIGN (σ́, R, PrWd), thereby ensuring that the initial syllable is not stressed unless it is heavy. ALIGN EDGES (σ́) is ranked above *CLASH, however, since a final syllable is

[5] The formulations of the alignment constraints adopted here are shorthand versions of constraints making reference to metrical grid marks (see Gordon 2002b for full formulations of the constraints).
[6] ALIGN EDGES (σ́) is adopted rather than an atomistic alternative requiring the right edge of a word to be aligned with a stressed syllable, i.e. ALIGN-WD-R (McCarthy and Prince 1993), since an analysis assuming separate ALIGN-WD-R and ALIGN-WD-L constraints results in increased overgeneration in a factorial typology (Gordon 2002b).

stressed even if it immediately follows another stress. The ranking ALIGN (σ́, R, PrWd) >> ALIGN EDGES (σ́) >> *CLASH is shown in (8).

(8)

tʃipisa 'He looks at you'	ALIGN (σ́, R, PrWd)	ALIGN EDGES (σ́)	*CLASH
☞ tʃiˈpiːˌsa	*	*	*
ˈtʃiːpiˌsa	**!		
tʃiˈpiːsa	*	**!	

Forms with a CVC prefix attached to a root beginning with a vowel-initial open syllable provide further evidence for the ranking of ALIGN EDGES (σ́) over *CLASH. In this case, the stress on the prefix is attributed to the prosodic word boundary intervening between the prefix and the root: ˌtʃim-aˈpiːˌla not *tʃim-ˈaːpiˌla 'S/he helps her/him for you'.

*CLASH is also violated when adjacent heavy syllables (CVV or CVC) are stressed, indicating that Prince's (1990) Weight-to-Stress Principle, WSP, outranks *CLASH. WSP also is ranked above ALIGN (σ́, R, PrWd). The ranking of WSP over both ALIGN (σ́, R, PrWd) and *CLASH is shown in (9).

(9)

ʃiːki 'buzzard'	WSP	ALIGN (σ́, R, PrWd)	*CLASH
☞ ˈʃiːˌki		*	*
ʃiːˈki	*!		

Finally, the ranking of ALIGN (σ́, R, PrWd) over ALIGN (σ́, L, PrWd) ensures that stress falls on the second rather than the first in a sequence of adjacent CV syllables.

The location of primary stress is bounded by the minor phrase. The situation is complicated by the differing directionality requirement in minor phrases with long vowels versus those lacking long vowels. In minor phrases without a long vowel, the final syllable carries primary stress, while in minor phrases with a single long vowel, the long vowel receives primary stress. In minor phrases with more than one long vowel, either the rightmost or leftmost long vowel can carry primary stress. All of the constraints necessary to account for the directional asymmetry in primary stress placement belong to constraint families already proposed in the literature. The formulation of these constraints for Chickasaw must refer, however, to the minor phrase.

Alignment constraints sensitive to primary stress are necessary to account for the variation in the location of primary stress in minor phrases with multiple long vowels. These constraints, formalized in Tesar (1997) and Bakovic (1998) as main foot alignment constraints and in Gordon (2002b) as main stress alignment constraints, are ALIGN (MAIN σ́, R, minPhr) and ALIGN (MAIN σ́, L, minPhr) and are essentially Prince's (1983) End Rule Right and End Rule Left encoded as alignment constraints. They are violated for each secondary stressed syllable separating the primary stressed syllable from the relevant edge of the minor phrase.[7] The ranking of ALIGN

[7] Note that reformulating ALIGN (MAIN σ́, R, minPhr) and ALIGN (MAIN σ́, L, minPhr) to count number of syllables rather than number of *secondary* stressed syllables separating the primary stressed syllable from the relevant edge results in increased overgeneration of unattested patterns (see Gordon 2002b for discussion).

(MAIN σ́, R, minPhr) and ALIGN (MAIN σ́, L, minPhr) is variable, thereby accounting for the option in Chickasaw of assigning primary stress to either the rightmost or leftmost long vowel. To account for the obligatory position of primary stress on the final syllable in minor phrases lacking long vowels, I assume, following Zoll's (1997) account of default-to-opposite stress, the existence of weight-sensitive alignment constraints in addition to generic alignment constraints. For Chickasaw, the relevant weight-sensitive alignment constraint requires that primary stressed "light" syllables be aligned with the right edge of a minor phrase. Given that light syllables for purposes of primary stress are those with a single vocalic mora, the constraint can be formulated as ALIGN (MAIN $σ́_{μ[+voc]}$, R, minPhr) (10).

(10) ALIGN (MAIN $σ́_{μ[+voc]}$, R, minPhr): A primary stressed light syllable (one containing a short vowel) is aligned with the right edge of a minor phrase.

ALIGN (MAIN $σ́_{μ[+voc]}$, R, minPhr) outranks the non-weight-sensitive primary stress constraint ALIGN (MAIN σ́, L, minPhr), as shown in (11).

(11)

issoba 'horse'	ALIGN (MAIN $σ́_{μ[+voc]}$, R, mPhr)	ALIGN (MAIN σ́, L, minPhr)
☞ ˌissoˈba		*
ˈissoˌba	*!	

Crucially, it must be ALIGN (MAIN $σ́_{μ[+voc]}$, R, minPhr) and not ALIGN (MAIN σ́, R, minPhr) responsible for the result in (11), since ALIGN (MAIN σ́, R, minPhr) may be ranked below ALIGN (MAIN σ́, L, minPhr), as indicated by the variability in the location of primary stress in minor phrases with multiple long vowels. ALIGN (MAIN σ́, L, minPhr) may not, however, be ranked above ALIGN (MAIN $σ́_{μ[+voc]}$, R, minPhr) or we would optionally get the leftmost stress being primary in minor phrases without long vowels, as in the failed candidate in (11).

Finally, ALIGN (MAIN σ́, R, minPhr) and ALIGN (MAIN σ́, L, minPhr) are ranked below a prominence constraint (Prince and Smolensky 1993) requiring that long vowels carry the most prominent stress in a minor phrase, PK-PROM ($μ_{[+voc]}μ_{[+voc]}$). This ranking attracts stress to the long vowel in minor phrases with a single non-final long vowel: aˈboːkoˌʃiʔ not *aˌboːkoˈʃiʔ 'river', ˌbakʃiˈjaːˌmaʔ not *ˈbakʃiˌjaːˌmaʔ 'diaper'.

Certain of the metrical constraints interact with faithfulness, as indicated by the phenomenon of rhythmic lengthening, which adds a mora to non-final stressed vowels in open syllables. *LAPSE must outrank the correspondence constraint (McCarthy and Prince 1993) ensuring that moras in the output have a correspondent in the input, DEP-IO (μ), since it is lapse avoidance that ultimately places the stresses triggering violations of DEP-IO (μ). DEP-IO (μ) is also ranked below a constraint requiring that stressed syllables be heavy (bimoraic), the converse of WSP, the STRESS-TO-WEIGHT PRINCIPLE, abbreviated SWP (Crosswhite 1998). The ranking *LAPSE, SWP >> DEP-IO (μ) is illustrated in (12).

(12)

tʃipisa ‘S/he looks at you’	*LAPSE	SWP	DEP-IO (μ)
☞ tʃiˈpiːˌsa			*
tʃipiˈsa	*!		
tʃiˌpiˈsa		*!	

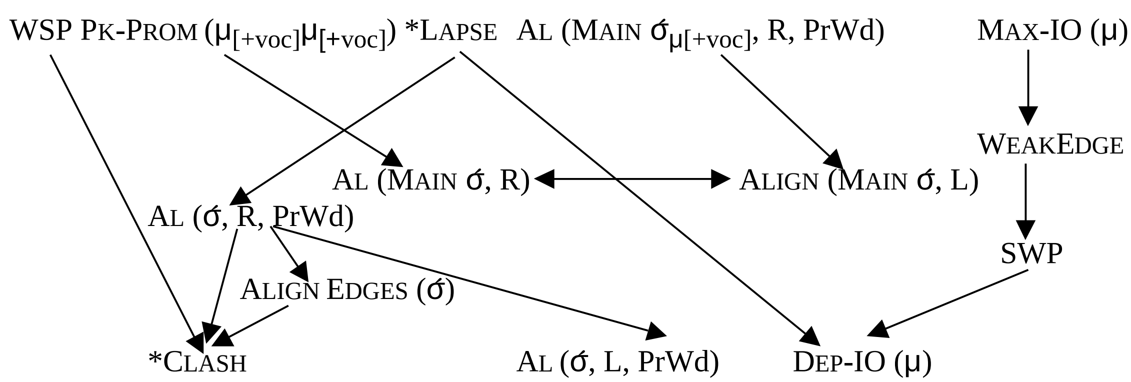
Vowel lengthening is suppressed in final syllables indicating that another constraint takes precedence over SWP. The relevant constraint may be formulated as WEAK EDGE following Spaelti (1994) and Bakovic (1996) (13).

(13) WEAKEDGE: The right periphery of the PrWd should be empty.

WEAKEDGE limits prosodic predicates at the right edge of a word; it has the effect of ensuring that a word-final vowel be monomoraic rather than bimoraic. It blocks lengthening both in a root-final stressed open syllable, e.g. piˈsa not *piˈsaː /pisa/ ‘S/he looks at her/him’, and in a CVC prefix preceding a vowel-initial root, e.g. ˌtʃim-aˌkanˈkaʔ not *ˈtʃiːm-aˌkanˌkaʔ ‘your chicken’. Because WEAKEDGE is ranked below MAX-IO (μ), however, underlying long vowels do not shorten word-finally, e.g. haˈʃaː ‘S/he is angry’.

The rankings for the constraints proposed thus far for Chickasaw are summarized in (14).

(14) Constraint rankings responsible for stress in Chickasaw



3 Pitch accents

We are now in a position to examine pitch accent placement and its interaction with word-level stress. Throughout the presentation, discussion of the pitch accent facts will be interleaved with a formal constraint-based analysis employing Pierrehumbert’s (1980) theory of intonation in which phrase-stressed syllables bear either a high or low tone termed a “pitch accent”.

The description of pitch accents described here is based on an acoustic and impressionistic analysis of approximately 3000 utterances elicited from a total of 15 speakers of Chickasaw (nine women and six men). Approximately half of the data is drawn from one speaker living in Los Angeles during the period between 1995 and the present, while the remainder of the data comes from sessions with 12 speakers in Oklahoma in 1996 and several sessions with two additional speakers conducted between 1996 and 2003 in Los Angeles. All of the speakers were over age 60; there are no known dialect differences within Chickasaw. Data was recorded on DAT tape and downsampled to 22.05kHz using PitchWorks (Scicon Research and Development) for analysis using pitch traces in conjunction with waveforms and spectrograms.

Each Chickasaw clause consists of a single Intonational Phrase (IP).[8] The final word in each IP contains a pitch accented syllable. The pitch accent characteristically has not only the highest pitch of the IP, but also is most prominent, i.e. the primary stressed syllable, of the IP in terms of duration and intensity. It thus is very similar in its phonetic realization as well as its location (rightmost content word in unmarked declaratives) to what has been termed the "nuclear pitch accent" or "nuclear tone" in many languages (see Ladd 1996 for discussion). I will continue to use the term "pitch accent" in the discussion that follows, since there is only one pitch accent per IP in Chickasaw and thus no need to distinguish nuclear and non-nuclear pitch accents.

Of particular interest in this section is the asymmetry between the location of the pitch accent in statements and questions. In statements, the pitch accent, a high tone, falls on the final syllable in order to satisfy an alignment constraint requiring that pitch accents align with the right edge of an Intonational Phrase. In questions, on the other hand, a constraint against crowding of the high pitch accent and the low boundary tone characteristic of questions takes precedence over the alignment constraint. As a result, the pitch accent only falls on the final syllable if it contains a long vowel, which by virtue of its two tone bearing moras is able to support multiple tones. If the final vowel is short, the pitch accent shifts leftward onto either a heavy penult or, if the penult is light, onto the antepenult, where the choice of penult or antepenult is conditioned by considerations of stress clash.

3.1 Statements

In Chickasaw statements[9], the most prominent syllable is the final one of the IP; it has the greatest intensity and highest f0 of the IP.[10] Given the overall prominence associated with an IP-final syllable in statements, in particular, heightened f0, we may assume that it carries a pitch accent. Representative examples of H* in statements appear in figures 1 and 2, both of which were uttered by the same female speaker. As figures 1 and 2 show, H* in statements is often realized relatively late in the syllable with which it is phonologically associated (see section 3.2 for further discussion of pitch accent timing). Following the pitch peak, there is either a high plateau (as in figure 1) or a slight fall in f0 (as in figure 2). Because the pitch accent may fall relatively late in the final vowel, it is often difficult to assess whether any boundary tones are present in statements. However, two pieces of evidence suggest that the pitch peak is attributed to a pitch accent and not a final boundary tone. First, there is often a small drop in f0 following H*. This drop is smaller than the one associated with a L% boundary tone in questions (see

[8] An Intonational Phrase, in turn, is composed of one of more Accentual Phrases, which are defined on the basis of their recurring tone pattern [LHHL], as well as certain segmental processes applying within Accentual Phrases but not across Accentual Phrase boundaries, e.g. vowel syncope, flapping (see Gordon 1999, to appear for discussion of intonational constituency in Chickasaw).

[9] Statements include imperatives and all affirmative declarations, both those with broad focus and those with narrow focus on a particular word within the statement.

[10] Unless the final syllable contains a short vowel and there is an earlier long vowel, the final vowel of the IP is also the longest of the IP. This lengthening in IP-final position, however, is not a decisive diagnostic for stress, given that IP-final position is often the site of lengthening cross-linguistically (Wightman et al. 1992).

section 3.2), suggesting a lack of a phonological boundary tone.[11] If there were a H% boundary tone in statements, one would expect a rising f0 pattern at the end of the IP. A second piece of evidence for the lack of a boundary tone in statements comes from the theory internal observation that Chickasaw avoids crowding both a pitch accent and a boundary tone on a single mora (see section 3.2). If a H% boundary tone were assumed for statements, this would represent a type of tonal crowding otherwise not found at the IP level in Chickasaw.

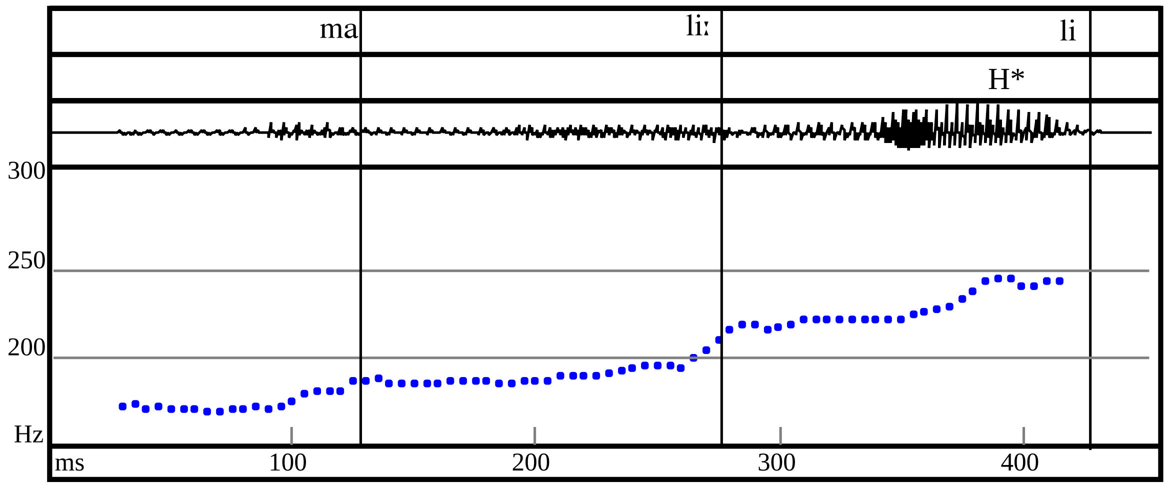


Figure 1. H* realized as plateau in statement IP **maˌliːˈlí** ‘He runs.’ (female speaker)

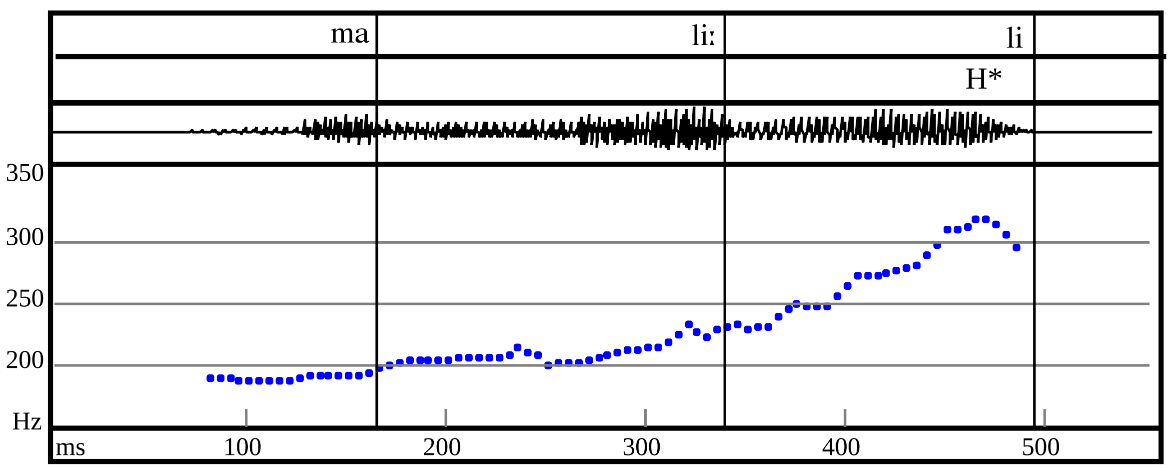


Figure 2. H* followed by f0 drop in statement IP **maˌliːˈlí** ‘S/he runs.’ (female speaker)

The attraction of the pitch accent to the right edge of an IP reflects an alignment constraint (McCarthy and Prince 1993) requiring that pitch accents align with the right edge of an IP. Because the pitch accent also gravitates to the right edge of question IPs (see section 3.2), this

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[11] I have also observed some tokens, however, with an f0 upstep following the H* in statements, suggesting H%. This optional H% seems to be an optional feature of two of the female speakers whose data I have analyzed.

constraint can be generalized to refer to all IPs, as in (15), following Gussenhoven's (2000) analysis of Roermond Dutch.

(15) ALIGN (T*, R, IP): A pitch accented syllable is aligned with the right edge of an IP.

3.2 Questions

A number of factors govern the choice of docking site for the pitch accent in questions. First, pitch accents are sensitive to a three-way syllable weight hierarchy: CVV > CVC > CV.[12]

Final CVV carries the pitch accent (marked by an acute accent in 16a). If the final syllable contains a short vowel, a CVV or CVC penult attracts the pitch accent (16b). If neither of these conditions is met, the antepenult carries the pitch accent (16c).[13] In words shorter than three syllables (monosyllables are minimally CVV [Munro 1996[14]]), the first syllable carries the pitch accent (16d), unless the final syllable contains a long vowel. Note that in cases where the antepenult carries the pitch accent, it is either CVC or CVV due to rhythmic lengthening (section 2), which conspires to block a sequence of two consecutive non-final CV syllables. Wh-words before the target word appear in parentheses in (16) and subsequent examples.

(16)a. (kaˌtiːˌmihˈtãː) **saˌhaːˈʃáː** 'Why am I angry?'
(ˌnanˈtaːt) **ˌokˈtáːk** 'What is a prairie?'
(kaˈtaːt) **ˈjáː** 'Who is crying?'
(ˌnanˈtaːt) **ʃiˈwáː** 'What is striped?'
b. **ˌiʃmaˈĺíːˌtam** 'Did you run?'
(ˌnanˈtaːt) **haˈtáːˌt͡ʃim** 'What turned color?'
(kaˈtaːt) **maˈĺíːˌli** 'Who's running?'
(ˌnanˈtaːt) **tʃiˈlákˌbi** 'What is dry and cracked?'
(ˌnanˈtaːt) **ˌisˈtókˌtʃank** 'What's a watermelon?'
(kaˈtiːˌjakˌta) **aˈkánˌkaʔ** 'Where's the chicken?'
(kaˈtaːt) **ˌbaːˈtámˌbiʔ** 'Who's Baatambi' ?'
c. **ˈmálliˌtam** 'Did s/he jump?'

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[12] For discussion of question morphology see Munro and Willmond (1994). Yes/no questions are marked with the suffix –ta in the present and –tam in the past. Wh-questions containing a predicate, i.e. those not consisting of only a noun, have no overt tense marking in the present tense and, in the past tense, may be marked with either the suffix –m or by tense suffixes also used in statements: –tok (perfective/proximal past), –tːoːk (remote past), both of which are suffixes on the verb. Wh-questions involving a noun and lacking an overt verb or special focus, e.g. katiːjakta akánkaʔ 'Where's the chicken?', place an interrogative particle on the wh-word and do not mark the noun.

[13] In questions, the location of the actual f0 peak associated with the pitch accent is influenced by two factors: vowel length and the distance of the syllable from the right edge of the IP. Averaged over a corpus of 10 words (5-6 repetitions each) in question-IP final position uttered by 3 female speakers, the pitch accent fell earliest in final long vowels: between 4% and 29% (depending on speaker) into the final vowel. Pitch accents occurred latest when associated with short vowels, typically early in the following consonant. Values for individual speakers ranged from 78% through a short voweled penult for one speaker to 129% through a short voweled antepenult for another speaker. For two of the three speakers, the pitch accent fell slightly later when associated with a short vowel in the antepenult than a short vowel in the penult. Pitch accents associated with non-final long vowels displayed the greatest interspeaker variation in their timing patterns but consistently fell later in antepenults than penults. For one speaker, pitch accents occurred early in the onset consonant (earlier than after a short vowel) following a long vowel both in the antepenult and penult. The other two speakers realized their pitch accents during the long vowels.

[14] But see Munro (1998) for discussion of CVC words in expressive constructions involving the word 'to say'.

ˈ**ʃíːpaˌta** ‘Is it stretchy?’
(ˌnanˈtaːt) **aˈbóːkoˌʃiʔ** ‘What’s a river?’
d. (ˌnanˌtahˈtãː) ˈ**pîˌsam** ‘What did s/he see?’
(ˌnanˈtaːt) ˈ**tíˌjak** ‘What’s a pine tree?’

Following an idea advanced in Hyman’s (1977) discussion of final stress avoidance and developed in Gordon (2000) (see also Prince and Smolensky 1993 for the OT constraint NONFINALITY banning final stress), the special ability of final CVV to carry the pitch accent in questions finds an explanation in terms of tonal crowding considerations unique to the right edge of an IP. Although English is fairly tolerant of tonal crowding in its intonational system (see Pierrehumbert 1980), many languages avoid crowding multiple tones onto a single syllable. Among the strategies for avoiding tonal crowding (see Ladd 1996: 132-6 for a review) are eliminating one or more of the crowded tones, as in Hungarian (Ladd 1983), phonetically undershooting one or more of the phonological tones, as in Greek (Arvaniti and Baltazani to appear), or shifting one of the tones to an adjacent syllable, as in Chickasaw, which shifts the pitch accent leftward if the final syllable contains a short vowel. Figure 3 illustrates a prefinal pitch accent; in this case, the pitch accent falls on the antepenult.

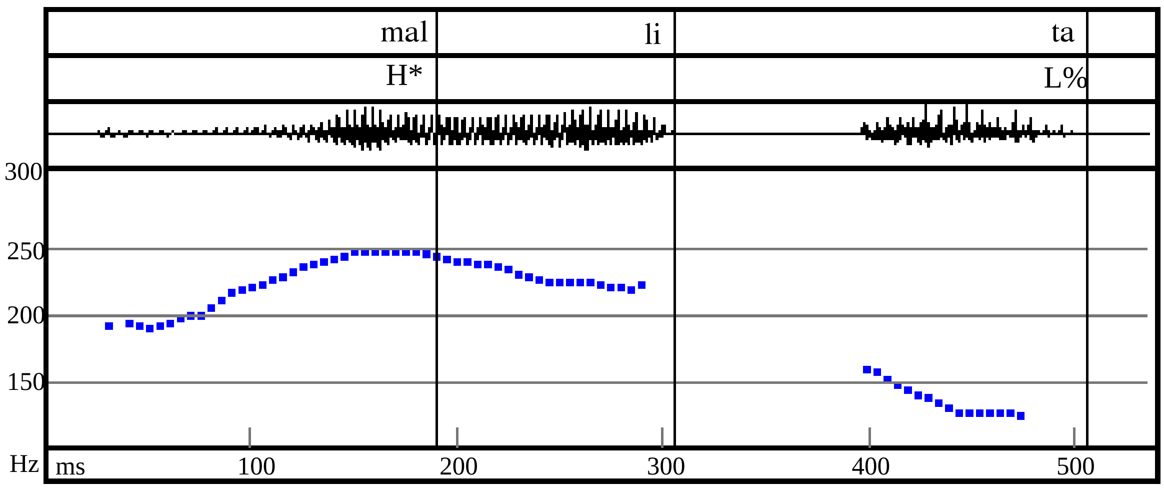

Figure 3. H* on antepenult followed by L% boundary tone in question IP ˈ**málliˌta** ‘Is s/he jumping?’ (female speaker)

If the final syllable is CVV, the pitch accent can safely dock on the beginning of the long vowel, while still allowing for the final low boundary tone, as shown in figure 4.

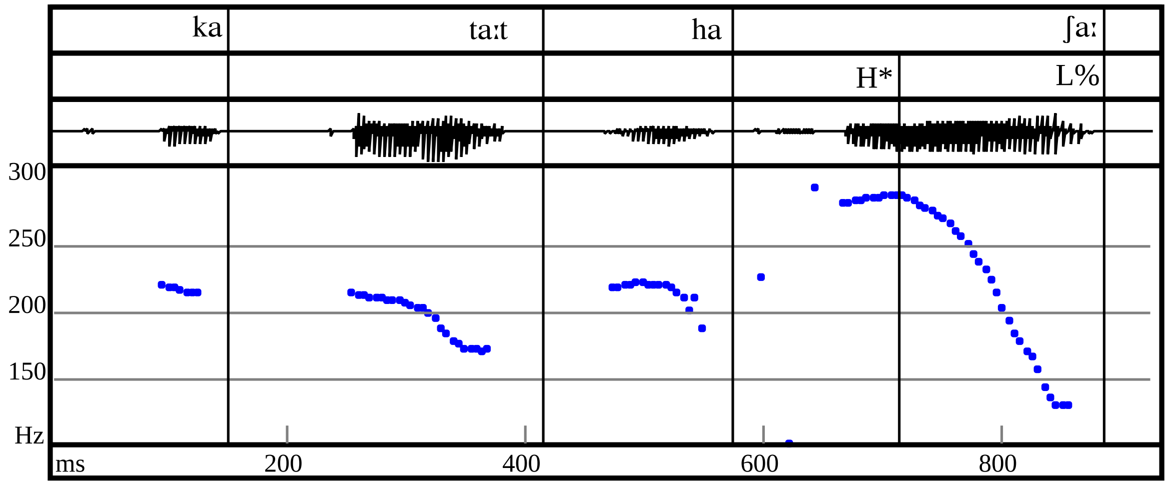

Figure 4. H* followed by L% boundary tone in question IP (kataːt) **haˈʃáː** 'Who is angry?' (female speaker)[15]

Tonal crowding avoidance can be formally captured by constraints governing the association between tones and weight-bearing units, e.g. moras. Following Gussenhoven (2000), we may assume a constraint which determines which moras count as tone bearing units and another constraint which bans more than one tone from docking on the same tone bearing unit. The first constraint Gussenhoven (2000) formalizes as *TBU *x*, where *x* is a variable ranging over potential tone bearing units.[16] For Chickasaw IP-level intonation, the tone bearing unit is the vocalic mora; the relevant constraint is thus (17).

(17) TBU μ
|
[+vocalic]

The second constraint Gussenhoven (2000) formalizes as *CROWD, which bans multiple tones linked to a single tone bearing unit (18).

(18) *CROWD: A TBU is associated with at most one tone.

TBU $\mu_{[+vocalic]}$ and *CROWD are highly ranked in Chickasaw; both are ranked above ALIGN (T*, R, IP) (see 19), since a non-vocalic mora is unable to license the boundary tone (third candidate in 19) and the pitch accent and boundary tone may not crowd onto a short vowel (second candidate in 19). As a result of this ranking, any final syllable not containing a long vowel will not carry a pitch accent.

[15] The wh-word /kataːt/ forms its own Accentual Phrase consisting of a H on the first syllable and the first mora of the second syllable followed by a L on the second vocalic mora of the second syllable. The elimination of the L initial AP tone is a common feature of disyllabic Accentual Phrases (see Gordon to appear for discussion).

[16] Gussenhoven's formulation is actually slightly different, since stress is also relevant for determining the docking of tones on tone bearing units in Roermond Dutch.

(19)

haʃaːtam L% 'Was s/he angry?'	TBU $\mu_{[+vocalic]}$	*CROWD	ALIGN (T*, R, IP)
☞ H* L% haʃaːtam			*
H* L% haʃáːtam		*!	
H*L% haʃáːtam	*!		

In addition to the two losing candidates considered in (19), there are other candidates that would allow for both the anti-tonal crowding constraints and ALIGN (T*, R, IP) to be satisfied. These candidates include one lacking a pitch accent, [haʃaːtam]L%, and one without a boundary tone, [haʃaːtám]. The second of these doomed candidates violates the faithfulness constraint requiring that underlying boundary tones be realized; this constraint, a member of the MAX-IO family (McCarthy and Prince 1995) is formalized in (20), following Myers (1997).

(20) MAX-IO-T: An input tone has a correspondent in the output.

The other failed candidate [haʃaːtam]L% is ruled out because it violates a constraint requiring that every IP have a pitch accent.[17] The requirement that every IP has a pitch accent parallels the requirement that every word have a stressed syllable, formalized by Prince (1983) as the Culminativity principle. In Optimality Theory, the effects of Culminativity at the IP level can be captured through a constraint requiring that the head word in an IP, i.e. the rightmost prosodic word, contain a pitch accent: ALIGN (HEADWD_{IP}, T*). Any form in which the rightmost word in the IP lacks a pitch accent will incur a violation of this constraint, which is formulated in (21).

(21) ALIGN (HEADWD_{IP}, T*): The head word in a IP contains a pitch accent.

Both MAX-IO-T and ALIGN (HEADWD_{IP}, T*) are ranked above ALIGN (T*, R, IP) (22).[18]

[17] MAX-IO-T is not relevant in ruling out failed candidates lacking a pitch accent, since pitch accents are not assumed to be underlyingly present.
[18] Note that the final vowel does not lengthen, indicating that WEAKEDGE outranks ALIGN (T*, R, IP).

(22)

haʃaːtam L% 'Was s/he angry?'	MAX-IO-T	ALIGN (HEADWD$_{IP}$, T*)	ALIGN (T*, R, IP)
☞ haʃáːtam L%			*
haʃaːtám	*!		
haʃaːtam L%		*!	

The rankings in (22) also account for the pitch accent on a CVC penult preceding a CV(C) final syllable, e.g. (kaˈtaːt) ˌbaːˈtámˌbiʔ 'Who's Baatambi?'.

Given the analysis thus far we would not expect the pitch accent to fall to the left of the penult, as the anti-tonal crowding constraint only has the power to push the pitch accent one syllable to the left of the ultima. Words containing a pitch accented antepenult represent a case in which a word-level stress constraint conditions the location of the pitch accent: in this case *CLASH outranks ALIGN (T*, R, IP). Recall from section 2 that all heavy syllables are stressed while the only light syllables that are stressed are word-final. If the pitch accent were to fall on a light penult, this would entail a stress clash between the pitch accented, and thus stressed, penult and the antepenult, which must be either underlyingly heavy or heavy due to rhythmic lengthening. The tableau in (23) illustrates the ranking of *CLASH above ALIGN (T*, R, IP).

(23)

mallitam L% 'Did s/he jump?'	*CLASH	ALIGN (T*, R, IP)
☞ ˈmálliˌtam		**
ˌmalˈlíˌtam	*!*	*

The second candidate fails because there are three adjacent stresses and thus two violations of *CLASH. This leaves the winner as the candidate with the pitch accent on the antepenult. The bypassing of a light penult in favor of the antepenult is significant, since it is the only instance of bottom-up pitch accent placement in Chickasaw, i.e. a word-level stress constraint outranking a phrase-level pitch accent constraint.

There are additional candidates not considered in (23) which do not have stress clashes but which fail to place the pitch accent and primary stress on the same syllable. For example, one candidate preserves the word-level primary stress on the ultima but positions the pitch accent on the penult, i.e. *ˌmallíˈta. That this candidate fails to emerge attests to the high ranking of a constraint requiring that the pitch accent and primary word-level stress fall on the same syllable. This requirement is addressed in the next section.

4 Prominence at different levels

This section examines the relationship between stress and pitch accents. In Chickasaw, as in other languages, the pitch accent and the primary stress of the phrase, and thus the word carrying the pitch accent, fall on the same syllable. This alignment of stress and the pitch accent is attributed to an alignment constraint requiring that the prosodic head of the phrase, i.e. the primary stress, and the pitch accent coincide. Chickasaw is unusual, however, in the relationship between the pitch accent and stress yielding this alignment of prominence. In Chickasaw, phonological constraints on pitch accent placement override certain stress constraints, resulting in stress differences between IP-non-final instantiations of a word, where pitch accents are irrelevant, and IP-final realizations, where pitch accents surface. This differs from the cross-linguistically typical relationship between pitch accents and stress, whereby phrasal pitch accents are projected from word-level stress. For example, in the English sentence *Mary painted sofas*, it is possible for the stressed syllable in any of the three words to carry a pitch accent, depending on focus. It would be unnatural, however, for an English speaker to place a pitch accent on the second syllable of *sofas* under any focus condition, since it is unstressed. Similarly, no pitch accents would be found on the unstressed syllables in *Mary* or *painted*. This differs from Chickasaw, where certain pitch accent and stress constraints can work antagonistically toward each other, resulting in stress asymmetries between pitch accented and non-pitch accented words. This section discusses several such conflicts arising between the phrasal pitch accent constraints discussed in section 3 and the word-level stress constraints introduced in section 2.

4.1 Word-level vs. phrase-level prominence interactions

Because pitch accents and primary stress coincide, words containing a pitch accent can be divided into two groups according to whether the location of primary stress in IP-final words is the same as or is different from the corresponding word in IP-non-final position. These patterns are summarized in Table 2. Primary and secondary stress are indicated using the appropriate IPA symbols, while the pitch accent is indicated by an asterisk preceding the pitch accented syllable. First, let us consider cases in which stress patterns in the two prosodic positions are identical. These cases include the following: statements in which the final word does not contain a long vowel before the ultima (type 1 in Table 2), and statements and questions in which the pitch accent falls on a CVV syllable (type 2), i.e. statements and questions ending in CVV (type 2a), questions ending in CVV.CV(C) (type 2b), and questions ending in CVV.CV.CV(C) (type 2c). Cases in which primary stress differs between IP-final words and IP-non-final words include the following: statements with a long vowel in pre-final position (type 3), and questions which fail to place the pitch accent on CVV (type 4), i.e. questions ending in a disyllabic word of the form CV.CV(C) (type 4a), questions ending in the disyllabic sequence CVC.CV(C) (type 4b), and questions ending in the trisyllabic sequence CVC.CV.CV(C) (type 4c). The latter two cases consist of two subtypes: one in which there is no CVV before the pitch accent (type 4bi and 4ci), in which case the final syllable carries primary stress IP-non-finally, and another in which a CVV precedes the pitch accent (type 4bii and 4cii), in which case the CVV carries primary stress IP-non-finally.[19]

[19] There is one case not in table 2 in which an optional stress variant found in IP-non-final words is not possible in IP-final position. Words containing multiple CVV may place primary stress on either the leftmost or rightmost CVV. However, in IP-final position, only the rightmost CVV could ever receive primary stress.

Table 2. Pitch accent and stress as a function of prosodic position

IP-non-final & final stress same

1 …ˈ *CV(C)]$_{\text{statement}}$, no CVV before ultima

2. Primary stressed CVV in either statements or questions

  2a …ˈ *CVV]$_{\text{statement, question}}$

  2b …ˈ *CVV.ˌCV(C)]$_{\text{question}}$

  2c …ˈ *CVV.CV.ˌCV(C)]$_{\text{question}}$

IP-non-final & final stress different

IP-non-final	*IP-final*
3 Statements with pre-final CVV	
…ˈ CVV…ˌσ]	…ˌCVV…ˈ *σ]
4. Questions with primary stress on syllable other than CVV	
4a $_{\text{PrWd}}$[CV.ˈ CV(C)]	$_{\text{PrWd}}$[ˈ *CV.ˌ CV(C)]
4b Questions ending in CVC.CV(C)	
4bi ˌCVC.ˈ CV(C), no CVV before penult	ˈ *CVC.ˌCV(C), no CVV before penult
4bii ˈ CVV…ˌCVC.ˌCV(C)	ˌCVV…ˈ *CVC.ˌCV(C)
4c Questions ending in CVC.CV.CV(C)	
4ci ˌCVC.CV.ˈCV(C), no CVV before antepen.	ˈ *CVC.CV.ˌCV(C) no CVV before antepen.
4cii ˈ CVV…ˌCVC.CV.ˌCV(C)	ˌCVV…ˈ *CVC.CV.ˌCV(C)

In virtually all cases in which stress is mismatched between IP-non-final and IP-final instantiations, a syllable carrying secondary stress IP-non-finally is promoted to primary stress IP-finally. There is one case (4a in Table 2), however, in which a syllable which is completely stressless in IP-non-final words is promoted to primary stress IP-finally: in disyllabic words of the form CVCV(C), the initial CV is stressless IP-non-finally and takes primary stress IP-finally, where the stress on the final syllable is relegated to secondary stress.

4.2 Phonetic manifestations of word-level vs. phrase-level stress asymmetries

There are phonetic differences in the realization of words which have different stress patterns in IP-non-final and IP-final position. Syllables that carry primary stress in IP-non-final position but not in IP-final position are realized with some combination of lesser intensity and duration and lowered f0 IP-finally. Conversely, syllables lacking primary stress IP-non-finally are realized with greater duration and intensity and higher f0 when carrying primary stress IP-finally.

The stress asymmetry between IP-final questions and IP-non-final disyllables of the type CVCV(C) (type 4a in Table 2) is especially clear phonetically, since it involves a shift between primary stress and lack of stress. In IP-non-final position, where the first syllable is stressless, it is subject to vowel devoicing and substantial shortening (in addition to being less intense and having lower f0), relative to its counterpart in question-final position, which carries primary stress and is thus fully voiced, longer and more intense (and realized with higher f0). The contrast between IP-non-final and question IP-final CVCV(C) is illustrated in figures 5 and 6, which contain spectrograms of the same word (uttered by the same female speaker) in the two prosodic contexts. The initial unstressed vowel in the IP-non-final token in figure 5 is voiceless and extremely short and has very little intensity relative to its longer and more intense counterpart in a question-final word. Furthermore, the final secondary stressed vowel in figure 6 is shorter and less intense than its primary stressed counterpart in figure 5.

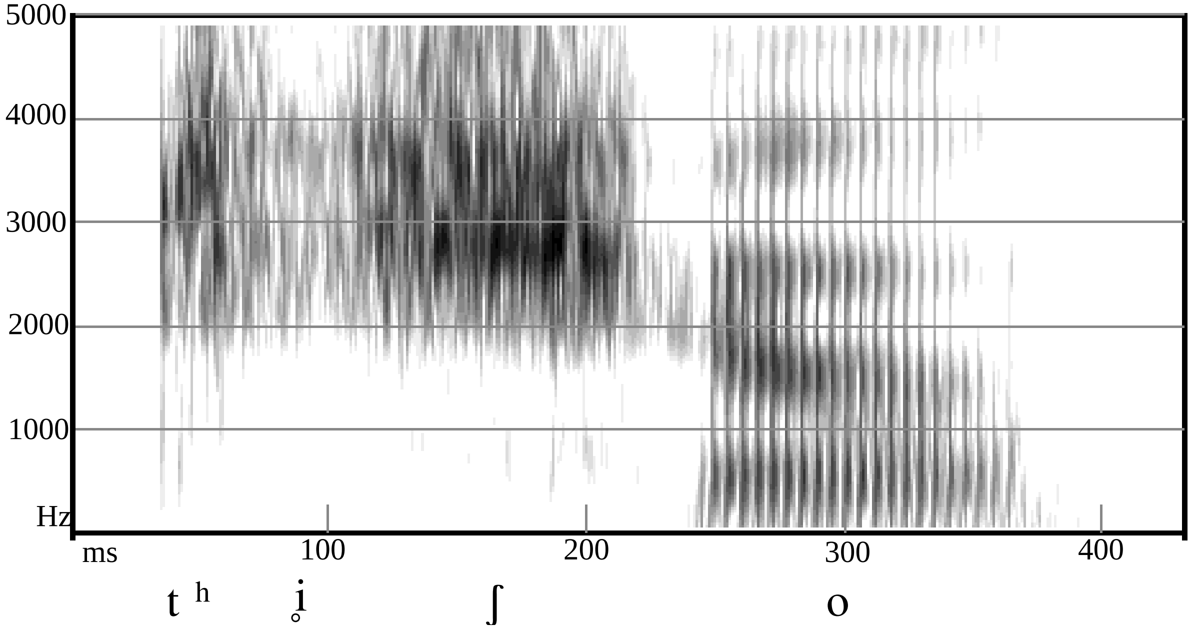

Figure 5. CVCV disyllable uttered in IP-non-final position in the statement [**tiˈʃo** piˌsaːˈtók] ‘S/he looked at the *tisho* (helper to a medicine man)’ (female speaker)

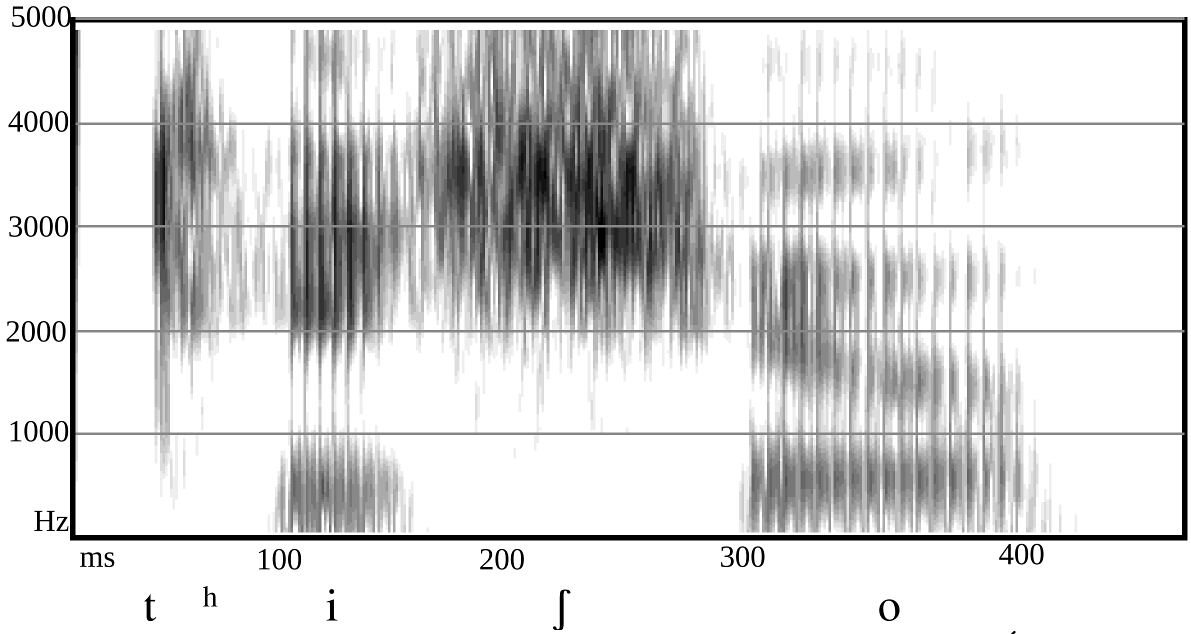

Figure 6. CVCV disyllable uttered in IP-final position of the question /ˌnanˈtaːt ˈ**tíˌʃo**/ ‘What is a *tisho*?’ (female speaker)

There are also phonetic differences between syllables that carry primary stress in one context, either IP-final or IP-non-final, but secondary stress in a different prosodic context. However, because the phonetic distinction between primary and secondary stress is subtler than the distinction between primary stressed and unstressed syllables, a controlled experiment is necessary to uncover the relevant phonetic differences.

In order to demonstrate primary vs. secondary stress asymmetries between IP-final and IP-non-final position, a series of phrases containing words with differing stress patterns dependent on their prosodic position was recorded by three female speakers of Chickasaw. Subjects repeated each phrase five times and three correlates of word-level stress (section 2), duration, intensity, and f0, were measured for syllables whose level of stress differed as a function of prosodic position.[20] The target words in the recorded phrase ended in a CVV syllable followed by either one or two CV(C) syllables. The target words were recorded IP-non-finally, where CVV received primary stress, and in IP-final position of both statements and questions, where the pitch accent and thus primary stress fell on a syllable to the right of the CVV. The corpus of examined words appears in table 3.

Table 3. Corpus for study of stress (target vowels in bold)

Statements	
IP-final	IP-non-final
aˌb**oː**koˈʃ**i**ʔ ‘river’	aˈb**oː**koˌʃ**i**ʔ ‘river’
ˌmaʃˌk**oː**ˈk**i**ʔ ‘Creek’	ˌmaʃˈk**oː**ˌk**i**ʔ ‘Creek’
naˌʃ**oː**ˈb**a** ‘wolf’	naˈʃ**oː**ˌb**a** ‘wolf’
ˌʃimmaˌn**oː**ˈl**i**ʔ ‘Seminole’	ˌʃimmaˈn**oː**lˌ**i**ʔ ‘Seminole’
tʃoˌk**aː**ˈn**o** ‘fly’	tʃoˈk**aː**ˌn**o** ‘fly’
Questions	
taˌl**aː**ˈn**o**mˌpaʔ ‘telephone’	taˈl**aː**ˌn**o**mˌpaʔ ‘telephone’
taˌʔosˌs**aː**ˈp**o**nˌtaʔ ‘bank’	taˌʔosˈs**aː**ˌp**o**nˌtaʔ ‘bank’
ˌokˌtʃ**aː**ˈl**i**nˌtʃiʔ ‘savior’	ˌokˈtʃ**aː**ˌl**i**nˌtʃiʔ ‘savior’

Figure 7-9 graphically displays duration, f0, and intensity values from 3 female speakers for syllables differing in their level of stress, primary or secondary, according to whether they are in IP-non-final words or in IP-final words. The relevant comparisons fall into two categories. First, primary stressed short vowels in IP-final syllables of statements and primary stressed short vowels in the CVC penult of IP-final words in questions are compared with their secondary stressed counterparts in IP-non-final words. Second, primary stressed long vowels in either the antepenult or penult of IP-non-final words are compared with their secondary stressed counterparts in IP-final words in statements and questions. For speaker 3, the IP-final words containing the measured vowels were confined to statements. Note that comparisons were not made of vowels in the same word, e.g. primary vs. secondary stressed vowels IP-finally and then

[20] Data was recorded onto DAT tape in an anechoic chamber using a high quality head mounted noise canceling microphone. Recordings were then transferred onto computer, downsampled to 22.05kHz and analyzed using the Praat software developed by Paul Boersma and David Weenink (www.praat.org).

IP-non-finally, since differences in vowel quality, surrounding consonants,[21] and phonemic vowel length (in the case of duration measurements) between target syllables made word-internal comparisons infeasible.

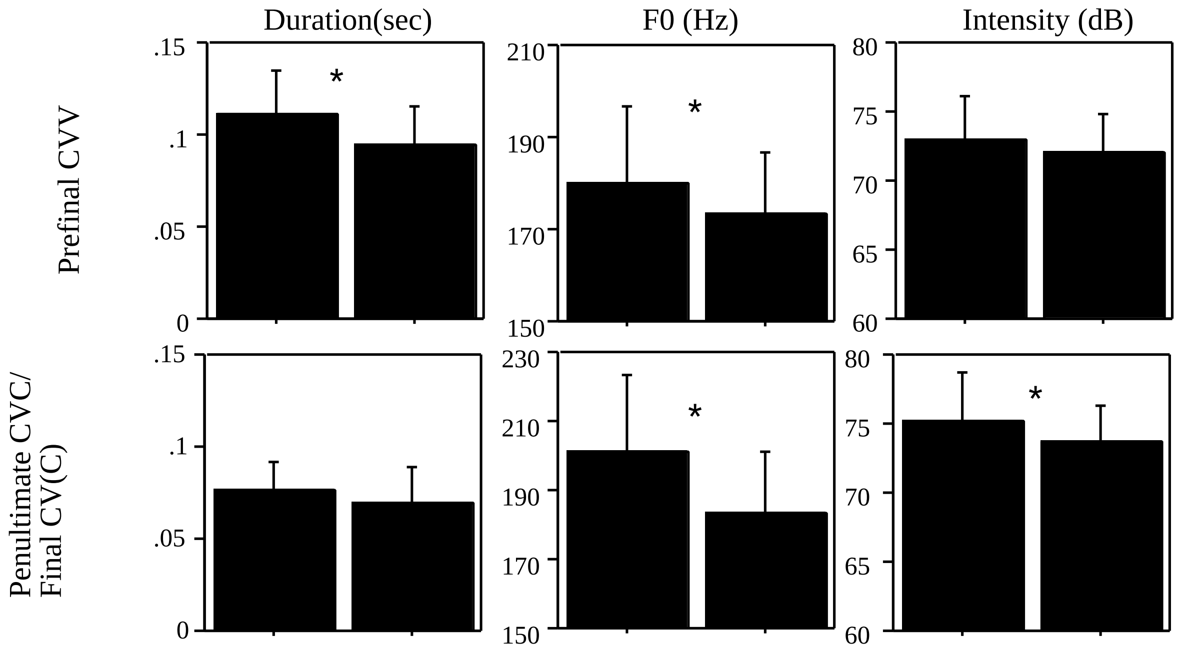

Figure 7. Duration, F0, and intensity values for primary (on left within each graph) and secondary stressed vowels (on right within each graph) in IP-non-final and IP-final position (speaker 1; statistical significance at minimally $p<.05$ according to unpaired t-tests is indicated by an asterisk)

[21] Differences in surrounding consonants are particularly problematic given that the majority of nouns, the class of words which are likely to occur both IP-non-finally and IP-finally (unlike verbs which almost always occur IP-finally due to the dominant SOV word order), end in glottal stop, which often triggers local lowering of f0 and creaky phonation (and concomitantly increased length and decreased intensity) in adjacent vowels.

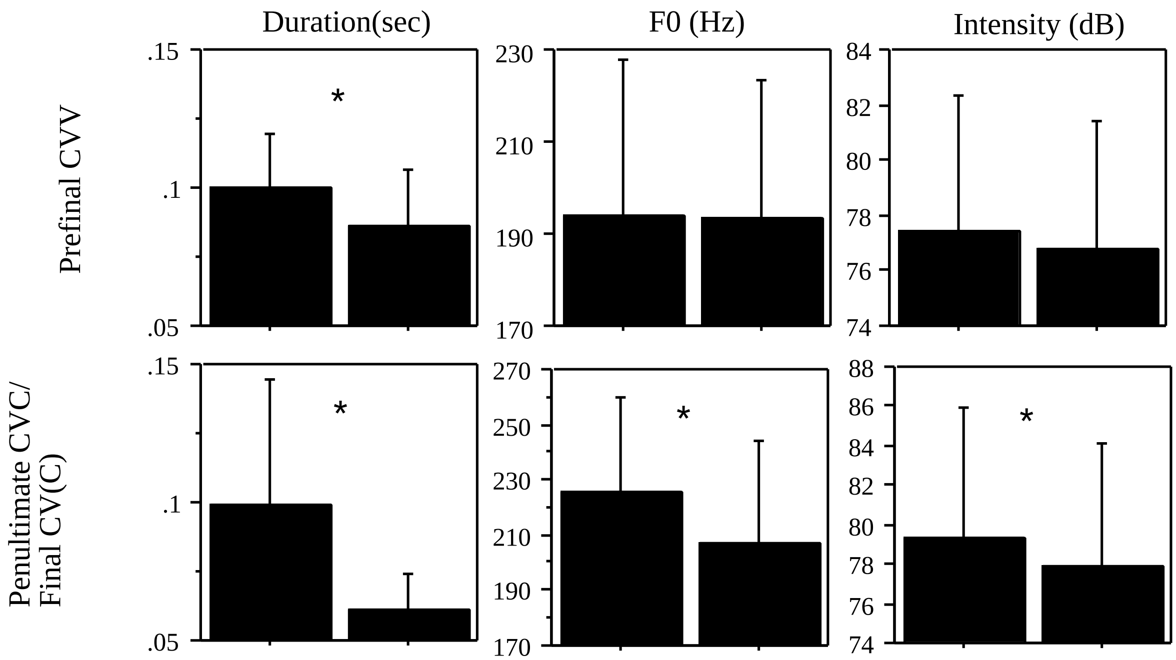

Figure 8. Duration, F0, and intensity values for primary (on left within each graph) and secondary stressed vowels (on right within each graph) in IP-non-final and statement IP-final position (speaker 2; statistical significance at minimally p<.05 according to unpaired t-tests is indicated by an asterisk)

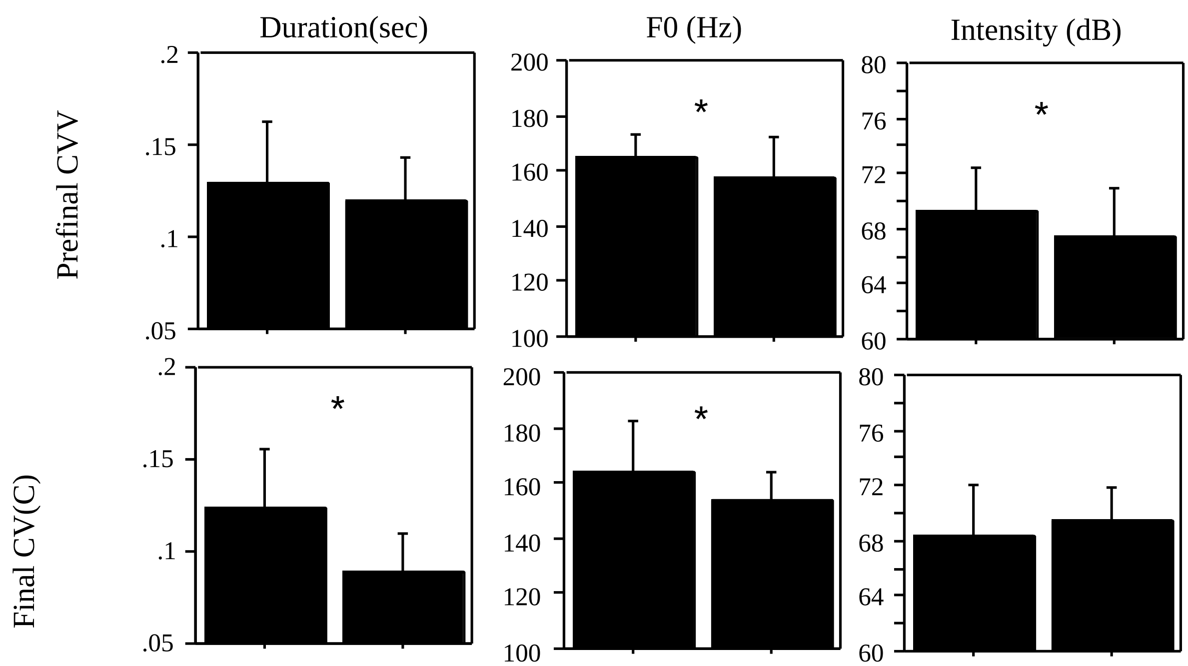

Figure 9. Duration, F0, and intensity values for primary (on left within each graph) and secondary stressed vowels (on right within each graph) in IP-non-final and statement IP-final position (speaker 3; statistical significance at minimally p<.05 according to unpaired t-tests is indicated by an asterisk)

In nearly all cases, primary stressed vowels have greater duration, higher f0, and greater duration than their secondary stressed counterparts, with many differences reaching significance.[22]

4.3 An OT analysis of word-level vs. phrase-level stress asymmetries

The link between syllables carrying a phonetic high tone, as syllables carrying a pitch accent do, and stress is a well-documented phenomenon in both tone and stress languages. In stress languages, pitch accents typically are realized on syllables carrying word-level stress, a situation found in limited cases in Chickasaw. The attraction of stress by pitch accented syllables is, in fact, well attested for *phrase level* stress, as certain focus conditions may give rise to a pitch accent in a word which is not the rightmost content word, the unmarked docking site for phrasal stress, cf. the Nuclear Stress Rule (Chomsky and Halle 1968, Selkirk 1984). If this pitch accent is the most prominent one in the phrase, i.e. the nuclear pitch accent, it attracts phrasal stress (cf. Selkirk's (1984) Pitch Accent Prominence Rule).

In Chickasaw, unlike the typical cross-linguistic pattern, pitch accents often dock on syllables that do not carry primary stress at the word-level; this results in a shift in word-level stress. This directionality, though rare in stress languages, is more akin to a phenomenon found in some tone languages, in which syllables associated with a high (or falling) tone attract stress (see De Lacy 2002).[23] Earlier work by Goldsmith (1987) also observes a close relationship between tone and stress in Bantu languages, but in the opposite direction: stressed syllables tend to attract high tone. His Tone-Accent Attraction Condition prohibits syllables with a lesser degree of stress from attracting tones away from syllables with greater stress.

To account for the Chickasaw attraction of stress by syllables carrying the pitch accent, a constraint is needed that is similar to De Lacy's tonal prominence constraints and Goldsmith's Tone-Accent Attraction Condition but that refers to pitch accents rather than tone. Parallel to the constraint requiring that the head word of an IP carry a pitch accent, this constraint can also be formulated as an alignment constraint. In this case, the relevant constraint requires that the pitch accent be aligned with the head syllable, i.e. primary stressed syllable of the phrase (24).

(24) ALIGN (T*, HEADσ_{IP}): A pitch accent falls on the head syllable of a phrase.

Because the head syllable of a phrase is also the head syllable of the word in which it occurs, ALIGN (T*, HEADσ_{IP}) has the effect of ensuring that pitch accented syllables carry word-level primary stress. ALIGN (T*, HEADσ_{IP}) is inviolable in Chickasaw as there are no cases in which a pitch accented syllable fails to also carry primary word-level stress. Working in conjunction with other pitch accent constraints including the inviolable constraint, ALIGN (HEAD$_{IP}$, T*), ALIGN (T*, HEADσ_{IP}) produces stress patterns in IP-final position that differ from their IP-non-final counterparts. We now consider these stress mismatches and the rankings they reveal.

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[22] Given that speakers vary in terms of which properties they use to signal stress difference (see section 2), it is not surprising that not all pairwise comparisons reach statistical significance.
[23] See also Selkirk (1984) for a similar requirement that pitch accented syllables be metrically prominent.

The pitch accent on the final syllable of statements ending in a word with a prefinal CVV (type 3 in table 2) shows that ALIGN (T*, HEADσ_{IP}), ALIGN (HEADWD$_{IP}$, T*), and ALIGN (T*, R, IP) are crucially ranked above PK-PROM ($\mu_{[+voc]}\mu_{[+voc]}$) and ALIGN (MAIN $\acute{\sigma}$, L, minPhr) (25).

(25)

abo:koʃiʔ 'It's a river'	ALIGN (T*, HDσ_{IP})	ALIGN (HDWD$_{IP}$, T*)	ALIGN (T*, R, IP)	PK-PROM ($\mu_{[+voc]}\mu_{[+voc]}$)	ALIGN (MAIN $\acute{\sigma}$, L, minPhr)
☞ aˌbo:ko'ʃíʔ				*	*
a'bo:koˌʃíʔ	*!				
a'bó:koˌʃiʔ			*!*		
a'bo:koˌʃiʔ		*!			

The second candidate fails due to its misalignment of primary stress and the pitch accent, while the third candidate does not have the pitch accent on the ultima, thereby violating ALIGN (T*, R, IP). The last candidate lacks a pitch accent in the rightmost word of the IP and thus violates ALIGN (HEADWD$_{IP}$, T*). The winner has primary stress and the pitch accent on the ultima.

Words with non-final pitch accents in IP-final position of questions diagnose further rankings. ALIGN (T*, HEADσ_{IP}), ALIGN (HEADWD$_{IP}$, T*), and the constraints governing tonal associations are ranked above both ALIGN (MAIN $\acute{\sigma}$, R, minPhr) and ALIGN (MAIN $\acute{\sigma}_{\mu[+voc]}$, R, minPhr).[24] These rankings are shown for a trisyllabic word ending in CVC.CVC without a long vowel before the penult (type 4bi) in (26).

[24] Recall from section 2.2 that ALIGN (MAIN $\sigma_{\mu[+voc]}$, R, minPhr) is ranked above both ALIGN (MAIN $\acute{\sigma}$, R, minPhr) and ALIGN (MAIN $\acute{\sigma}$, L, minPhr).

(26)

(nantaːt) istoktʃank L% ‘What’s a watermelon?’	*CROWD	TBU $\mu_{[+vocalic]}$	ALIGN (T*, HEADσ_{IP})	ALIGN (HD$_{IP}$, T*)	ALIGN (MAIN $\acute{\sigma}_{\mu[+voc]}$, R, minPhr)	ALIGN (MAIN σ́, R, minPhr)
☞ H* L | | ˌisˈtókˌtʃank					*	*
H*L | | ˌisˌtokˈtʃánk		*!				
H*L |/ ˌisˌtokˈtʃánk	*!					
H* L | | ˌisˌtókˈtʃank			*!			
L | ˌisˌtokˈtʃánk				*!		

Disyllables of the form CVCVC[25] (type 4a in table 2) reveal one additional set of rankings: ALIGN (T*, HEADσ_{IP}), ALIGN (HEADWD$_{IP}$, T*), and the constraints governing tonal associations are prioritized over *CLASH and ALIGN (σ́, R, PrWd), as the initial primary stress in questions adds a non-final stress which clashes with the secondary stress on the final syllable (27).

[25] CVCV disyllables diagnose the same rankings, except for ones involving TBU $\mu_{[+vocalic]}$, since there is no coda consonant that could serve as a potential docking site for tone.

(27)

<table>
<tr><th>(nantaːt) tijak L%
‘What is a pine tree?’</th><th>*CROWD</th><th>TBU
$\mu_{[+vocalic]}$</th><th>ALIGN (T*, HEADσ_{IP})</th><th>ALIGN (HDWD$_{IP}$, T*)</th><th>ALIGN ($\acute{\sigma}$, R, PrWd)</th><th>*CLASH</th></tr>
<tr><td>☞ H L
| |
ˈtí̩jak</td><td></td><td></td><td></td><td></td><td>*</td><td>*</td></tr>
<tr><td>H L
|⁄
tiˈják</td><td>*!</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>HL
| |
tiˈják</td><td></td><td>*!</td><td></td><td></td><td></td><td></td></tr>
<tr><td>H L
| |
tíˈjak</td><td></td><td></td><td>*!</td><td></td><td></td><td></td></tr>
<tr><td>L
|
tiˈjak</td><td></td><td></td><td></td><td>*!</td><td></td><td></td></tr>
</table>

4.4 Phrase-level stress vs. pitch accent constraints

Throughout the paper thus far I have assumed an analysis in which the divergence between IP-non-final and IP-final stress patterns is a function of constraints governing the location of the pitch accent in IP-final words working in conjunction with a constraint requiring that pitch accented syllables carry primary stress. Thus, in the view adopted here, the pitch accent constraints are responsible for the location of primary stress in IP-final words. There is an alternative position, however, which I now consider: that a separate set of phrasal stress constraints dictates the location of stress in IP-final words and that pitch accent placement is predictable from phrasal stress through highly ranked ALIGN (T*, HEADσ_{IP}). This position is similar to the approach adopted here in assuming that ALIGN (T*, HEADσ_{IP}) produces alignment of phrasal stress and pitch accents, but is different in that it assumes that phrase-level stress dictates pitch accent placement rather than vice versa. The two approaches do not make different empirical predictions in Chickasaw, since phrasal stress and the pitch accent are physically equivalent realizations of the abstract notion of prominence in Chickasaw. Only in a hypothetical language in which ALIGN (T*, HEADσ_{IP}) were violated and phrasal stress and the pitch accent could fall on different syllables would the two analyses be separable. At stake is the formalism capturing the location of phrase level prominence in Chickasaw.

One argument for pitch accent constraints rather than phrasal stress constraints centers on the inherently intonational rather than stress-driven nature of certain of the factors governing the location of prominence in phrase-final words. First, the rejection of the pitch accent, and thus primary stress, by phrase-final syllables containing a short vowel finds a clear intonational explanation in terms of tonal crowding factors unique to final position, as argued in section 3.2. Specifically, short voweled syllables only have a single tone bearing unit and thus are unable to support both the pitch accent and the final boundary tone. This avoidance of tonal crowding parallels a similar restriction against contour tones on long vowels observed in many languages. Further support for the tonal basis for phrase-final stress avoidance in Chickasaw comes from the observation that final syllables in non-phrase-final words, where tonal crowding issues are not as compelling, potentially attract primary stress whether they contain a long vowel or not. This asymmetry between phrase-final syllables, which resist stress, and word-final but not phrase-final syllables, which freely attract stress, is observed in several other languages (see section 4.6 for further discussion), e.g. Cayuga (Chafe 1977, Foster 1982, Michelson 1988), Onondaga (Chafe 1970, 1977, Michelson 1988), Seneca (Chafe 1977, Michelson 1988), Central Alaskan Yupik (Leer 1985, Miyaoka 1985, Woodbury 1987), and Hill Mari (Ramstedt 1902). If stress avoidance rather than pitch accent avoidance were driving the rejection of stress by phrase-final short vowels, the tonally-driven account of the Chickasaw facts would lose much of its explanatory power: both the asymmetry between phrase-final short and long vowels and the asymmetry between phrase-final and non-phrase-final words would be accidental byproducts of different stress constraints operative at the word- and phrase-level. Under the proposed account in which tonal conditions unique to phrase-final position govern pitch accent placement, which in turn dictates phrasal stress, both asymmetries find an explanatory basis.

In summary, while an analysis based on separate phrase-level and word-level stress constraints cannot be definitively ruled out, an account drawing on constraints governing pitch accent placement appears to be more explanatory and more easily generalized to intonational phenomena in other languages.

4.5 Top-down effects in Optimality Theory

Word-level vs. phrase-level phonological asymmetries are well documented for a variety of phenomena. Many tone languages display phrase-level tonal processes that create tonal asymmetries between phrase-final and non-final words, e.g. Rice 1987 on Slave, Hyman 1990 on Kinande, McHugh 1990 on Chaga, Kanerva 1990 on Chichewa, Kenstowicz and Kisseberth 1990 on Chizigula). Vowel length patterns also may differ between phrase-final and non-final words, e.g. Kisseberth and Abasheikh 1974 on Chimwi:ni, Chafe 1970 on Onondaga, Prince 1975, McCarthy 1979, Dresher 1980, Rappaport 1984, Churchyard 1989, 1999 on Tiberian Hebrew (see below). Both tonal and length asymmetries require recourse to constraints operative in particular phrasal contexts. These phrase-sensitive constraints may interact with other more general non-phrasally governed constraints, much as the Chickasaw pitch accent constraints operative in phrase-final words have been shown here to interact with generic metrical stress constraints.

More generally, the interaction between phrasal pitch accents and word-level stress in Chickasaw instantiates a type of top-down effect explicitly predicted to occur in a theory like OT, in which phrase-level constraints interact with and potentially outrank certain word-level constraints.[26] Top-down effects are well documented in the literature and have been effectively

[26] This is not to say that no mechanisms for accounting for bottom-up effects have been proposed in the OT literature. Such devices include cyclic or serial constraint evaluation (e.g. Orgun 1995, Kenstowicz 1995, Booij 1997, Hale et al. 1997), sign-based morphology (Orgun 1996), output-output correspondence (e.g. Benua 1995, 1997, McCarthy and Prince 1995, Kenstowicz 1996, Ito and Mester 1997, Steriade 2000), and morphologically-informed alignment constraints (e.g. McCarthy and Prince 1993 on Asheninca Campa, Cohn and McCarthy 1998 on

analyzed using the type of higher level outranks lower level constraint interactions proposed here for Chickasaw. For example, Prince and Smolensky (1993:28-30) show that foot parsing constraints take precedence over the syllabification constraint banning onsetless syllables in Tongan, unlike the more typical cross-linguistic pattern in which the metrical parse requires an already syllabified string of segments. In a somewhat different type of top-down effect involving word-level and phrase-level phonology, McCarthy (2002:146-9) shows how function words asymmetrically cliticize to a following content word in phrase-non-final position in English but are blocked from cliticizing in phrase-final position ("I gave the book [tə Bill]" vs. "Who did you give the book [tu]?") by the ranking of a constraint requiring that lexical words align with the right edge of a prosodic word above a constraint requiring that prosodic words contain a content word. The interactions between stress and pitch accents observed in Chickasaw represent a somewhat novel type of top-down effect in the OT literature.

4.6 A typology of word-level vs. phrase-level prominence

Although the broad typological investigation of interactions between stress and intonation is in its relative infancy, there are certain recurring patterns that have already become evident. One apparently universal property of stress asymmetries is the alignment of pitch accents and stress. Thus, as in Chickasaw, it appears that all pitch accented syllables are also stressed in languages of the world.[27] Furthermore, if a word carries a single pitch accent, that pitch accented syllable will carry the primary stress of the phrase in which it appears. Thus, ALIGN (T*, HEADσ_{IP}) is a likely candidate for a universally inviolable constraint.

The major source of cross-linguistic variation concerns the strategy adopted for satisfying ALIGN (T*, HEADσ_{IP}). In many languages, English included, pitch accents are projected from word-level stress in bottom-up fashion seeking out syllables that carry stress at the word-level. Thus, in English, only syllables carrying word-level stress may carry pitch accents.[28] This bottom-up assignment of pitch accents results from the ranking of word-level stress constraints above all constraints specific to the placement of pitch accent.

As we have seen, Chickasaw displays a different strategy for satisfying ALIGN (T*, HEADσ_{IP}). In Chickasaw, certain phrase-level intonational constraints, in particular the pitch accent alignment constraint ALIGN (T*, R, IP) and the tonal association constraints *CROWD and TBU $\mu_{[+vocalic]}$ outrank certain word-level stress constraints. This ranking relationship results in a leftward stress shift in certain words in final position of questions relative to their non-phrase-final counterparts and a rightward stress shift in certain words in final position of statements.

Although this type of "top-down" assignment of stress in phrase-final words has received less attention in the theoretical literature, Chickasaw is not the only language displaying stress asymmetries between phrase-final and phrase-non-final words. A recurring pattern is for final stress avoidance to be stronger for phrase-final words than for phrase-non-final words, a pattern also observed in Chicakasaw. As we have seen, in Chickasaw questions, only a phrase-final

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Indonesian). These devices, at least as presented in the literature, do not preclude top-down interactions between phrase-level and word-level prominence of the kind found in Chickasaw.

[27] Ladd (1996:129-131) discusses isolated cases of pitch accents on unstressed syllables in Italian and Dyirbal.

[28] Association of pitch accents to completely unstressed syllables in English is found only in very specialized circumstances. For example, an individual syllable might be focussed when a speaker repeats a word emphasizing a syllable that was misinterpreted, as in Selkirk's (1984:271) example, "I said coFFIN, not coFFEE".

syllable containing a long vowel is able to support both the pitch accent and the low boundary tone. In conjunction with the requirement that the pitch accented syllable carry the primary stress of a phrase, this restriction repels the primary stress from phrase-final syllables not containing a long vowel. This contrasts with word-final but non-phrase-final syllables, which carry primary stress unless there is a long vowel in a pre-final syllable. A similar greater stringency of final stress avoidance in phrase-final position, where tonal crowding considerations are relevant, relative to non-final position is reported for several other languages, including Cayuga (Chafe 1977, Foster 1982, Michelson 1988), Onondaga (Chafe 1970, 1977, Michelson 1988), Seneca (Chafe 1977, Michelson 1988), Hill Mari (Ramstedt 1902), Central Alaskan Yupik (Leer 1985, Miyaoka 1985, Woodbury 1987), and Tiberian Hebrew (Prince 1975, McCarthy 1979, Dresher 1980, Rappaport 1984, Churchyard 1989, 1999). The difference between Chickasaw and these languages lies in the association of a low final boundary tone with questions in Chickasaw but with statements in most languages, including the aforementioned languages displaying phrase-level vs. word-level prominence asymmetries.

We now consider these languages, starting with the three closely related Northern Iroquoian languages, Cayuga, Seneca and Onondaga, in which stress falls on the final syllable of words not in phrase-final position but falls on a syllable to the left of the ultima in phrase-final words. In Cayuga phrase-final words, stress falls on an open penult, which undergoes lengthening due to a rule of penultimate open syllable vowel lengthening. In words containing a closed penult, stress falls on the rightmost non-final even numbered syllable counting from the left edge of a word. Phrase-medially, an additional stress appears on the final syllable (Foster 1982:60). Of interest for present purposes is the final stress present phrase-non-finally but not phrase-finally. This additional phrase-non-final stress is attributed to the ranking of ALIGN EDGES (σ́) above *CLASH as in Chickasaw. Phrase-finally, ALIGN EDGES (σ́) is overridden by a tonal crowding constraint banning a pitch accent and a final boundary tone from docking on the same syllable. Unlike in Chickasaw, this constraint bans a contour tone on all final syllables, even those containing a long vowel. This intonationally-driven analysis finds support from the phonetic work on Cayuga by Doherty (1993), who shows that phrases characteristically end in a low tone while stress is associated with a high tone, analyzable as a pitch accent in the present context.

A similar avoidance of stress on phrase-final syllables is found in related Onondaga and Seneca. In both languages, as in Cayuga, stress falls on the final syllable of words not in phrase-final position, but on a pre-final syllable in phrase-final words. Onondaga and Seneca differ in their stress patterns found in phrase-final words. In Seneca, stress falls on the rightmost even-numbered closed syllable or even-numbered syllable immediately preceding a closed syllable. In Onondaga, stress in phrase-final words is characteristically penultimate.[29] Despite these differences between the two languages, the same basic asymmetry between phrase-final and non-final words observed in Cayuga is also is observed in both Onondaga and Seneca: final stress avoidance is stronger in phrase-final than in phrase-non-final position reflecting tonal crowding avoidance in phrase-final words.

Hill Mari (Ramstedt 1902) also asymmetrically positions stress on the final syllable of words in phrase-non-final position, and on the penultimate syllables of words in final position. The

[29] Certain suffixes attract stress onto word-final syllables even phrase-finally, while others reject stress, instead forcing it onto the antepenult. Conversely, certain suffixes reject stress in final syllables, even in phrase-non-final words. Also, in Onondaga, the highest pitch in a word has shifted one syllable leftward from the primary stress in many cases, though Chafe (1977) reports that the primary stressed syllable also carries heightened pitch (see Chafe 1970, 1977, Michelson 1988 for further discussion of Onondaga).

situation in Hill Mari, however, is complicated by a prohibition against stressed centralized vowels. Because of this prohibition, stress can potentially shift to a syllable to the left of the default stress location depending on phrasal position.

A similar asymmetry between phrase-final and phrase-non-final words is observed in Central Alaskan Yupik, in which stress basically follows an iambic pattern, with the rightmost stress being strongest (Miyaoka 1985:56) and carrying the most prominent pitch accent (Woodbury 1989). Of interest is a phrase-level vs. word-level stress asymmetry reported by Miyaoka (1985). The final syllable of a phrase-final syllable rejects stress even if it falls in a metrically prominent position, i.e. the second syllable of an iambic foot: nuˈnaːtukut 'we are visiting' /nunatukut/, *nuˌnaːtuˈkut (Miyaoka 1985:69). Conversely, the final syllable of a phrase-non-final word attracts stress even if it is not in a metrically prominent position: qaˈjaːˌmun # teˈkiːtuq 'he came to the kayak' /qajamun # tekituq/ *qaˈjaːmun (Miyaoka 1985:72). Following the analysis of Chickasaw, the presence of this additional stress on the ultima of phrase-non-final words is attributed to the ranking of ALIGN EDGES (σ́) over *CLASH. Phrase-finally, where tonal crowding between the pitch accent and the boundary tone is relevant, an anti-tonal crowding constraint banning contour tones on any syllable regardless of whether it contains a long vowel overrides ALIGN EDGES (σ́) and *LAPSE. The result is loss of the final stress present in phrase-non-final words. A twist on this pattern is found in the Nunivak dialect, in which stress retracts from a phrase-final syllable onto the penult (with gemination of the following consonant), thereby creating a clash with the stress on the antepenult, cf. non-Nunivak maˈliːɣutuq vs. Nunivak maˈliːˌɣuttuχ 'he goes along with' (Miyaoka 1985:66). This pattern reflects the ranking of *LAPSE above *CLASH, unlike in other varieties of Central Alaskan Yupik, where the ranking of *CLASH above *LAPSE precludes retracting stress onto the penult phrase-finally. As in Cayuga, the intonationally-driven analysis of final stress avoidance in Yupik finds support from the intonational phonology of Yupik. Woodbury (1989) reports that pitch accents are high tones in Yupik, while the unmarked final declarative boundary tone is a low tone.

A slightly different kind of asymmetry between phrase-final and non-final words is found in Tiberian Hebrew, an asymmetry involving both position of stress and length of stressed vowels. In Tiberian Hebrew (Prince 1975, McCarthy 1979, Dresher 1980, Rappaport 1984, Churchyard 1989, 1999), stress is generally constrained to fall on one of the final two syllables of a word, where the location of the stress within this window is simultaneously sensitive to syllable weight and the position of a word within a phrase. Phrase-finally, stress falls on the final syllable if it is closed and on the penult if the final syllable is open. (All open final syllables contain long vowels.) Phrase-medially, final stress avoidance is less stringent: it falls on final closed syllables and on final open syllables in words ending in the underlying disyllabic string CVCVV (where the vowel in the open penult syncopates). Stressed vowels also surface as long phrase-finally even in closed syllables, unlike their phrase-non-final counterparts. The relevant stress and length patterns are summarized in table 4.

Table 4. Word-level and phrase-level stress in Tiberian Hebrew

Penult	Ultima	Underlying	Phrase-non-final	Phrase-final	Gloss
CV	CVV	/katabu/	kàːtbúː	kaːtáːbuː	they wrote
CV	CVC	/katab/	kaːtáb	kaːtáːb	he wrote
CVC	CVV	/katabti/	kaːtábtiː	kaːtáːbtiː	you (f.sg) wrote
CVC	CVC	/katabtem/	kətabtém	kətabtéːm	you (m.pl) wrote

While a complete analysis of Tiberian Hebrew stress goes beyond the scope of this work (see the above references for analysis), relevant for present purposes is the fact that phrase-final words show different stress and length patterns from their non-final counterparts. The lengthening of stressed vowels (and the non-application of syncope) in phrase-final words may be viewed as a byproduct of the greater prominence associated with phrasal stress relative to word-level stress. This analysis adopts the plausible assumption that stressed syllables in phrase-final words were associated with a pitch accent in Tiberian Hebrew, in keeping with the cross-linguistic tendency for the rightmost content word to carry a pitch accent in unmarked declarative utterances (see Pierrehumbert 1980 for English and Ladd 1996 for a cross-linguistic overview).

The analysis of contextual stress asymmetries adopted for Chickasaw extends to other languages with documented differences in stress patterns characteristic of phrase-final and phrase-non-final words. According to the dominant pattern, in phrase-final words, intonational factors unique to the right edge of an Intonational Phrase conspire to repel stress from final syllables. In Chickasaw, this stress repulsion effect is somewhat weaker than in Yupik, Onondaga, Seneca, Hill Mari, and Cayuga, since IP-final long vowels may carry stress in Chickasaw but not in the other languages with phonemic vowel length.[30] I would speculate that other languages with phrase-final vs. non-phrase-final stress asymmetries will be discovered as more detailed phonetic and phonological case studies of prominence are conducted. Evidence for this is suggested by Hyman's (1977) cross-linguistic study of stress, which finds that penultimate stress is extremely common relative to peninitial stress. As Hyman suggests, the preference for penultimate stress is plausibly due to intonational factors: penultimate stress is as close to the right edge of a word without crowding stress and the final fall characteristic of declaratives onto a single syllable. At the left edge, there are less likely to be intonational reasons to push stress from the initial syllable rightward. This intonationally-driven analysis relies on the plausible assumption that stress patterns reported in primary sources are largely based on isolation forms where a word is in phrase-final position. Perhaps future research comparing isolation words with words embedded in a phrasal context will reveal additional languages possessing stress asymmetries of the Chickasaw, Yupik, and Northern Iroquoian type.

In summary, given our present knowledge of positionally-governed stress asymmetries, it is clear that there exist at least two possible relationships between word-level stress and phrasal stress as reflected in pitch accent placement. One pattern, the "bottom-up" pattern characteristic of many languages, including Chickasaw to a limited extent, involves the assignment of pitch accents to syllables already carrying word-level stress. Another pattern, one found in Chickasaw, is characterized by "top-down" assignment of pitch accents on the basis of pitch accent constraints that function orthogonally to stress constraints. Consistent across both types of languages is the alignment of pitch accents and stress.

5 Morphological factors governing pitch accent placement

Morphological considerations can override certain of the strictly phonological conditions governing the location of the pitch accent and create additional scenarios in which IP-final stress patterns do not match those of IP-non-final words. This section discusses two such interactions between the phonology of pitch accent placement and morphology. The first of these concerns

[30] This excludes Hill Mari, which lacks phonemic vowel length.

the rejection of stress by prefixes, a property which is attributed to the fact that prefixes rejecting the pitch accent belong to a different prosodic word than the root. The requirement that the pitch accent fall within the rightmost word of an IP thus ensures that prefixes do not carry a pitch accent, except if the only syllable in the rightmost word is CV, in which case higher ranking anti-tonal crowding constraints push stress onto a prefix. The second interaction between morphology and pitch accents involves the attraction of the pitch accent by suffixes. Unlike prefixes, suffixes cannot be argued to occur in a different prosodic constituent from the root. To account for the behavior of suffixes, a morphologically informed constraint requiring that suffixes carry a pitch accent is invoked.

5.1 Prefixes

The pitch accent may not fall to the left of the root, even if phonological factors predict otherwise. Thus, in the words in (28a), the pitch accent falls on the penult, the leftmost syllable in the root (indicated by brackets), and not the antepenult, a prefix, even though the penult is light and the ultima contains a short vowel.

If, however, the only syllable in the root is in final position and does not contain a long vowel, the restriction against prefixal pitch accents is lifted (28b), indicating that the prohibition against tonal crowding on syllables containing a short vowel takes precedence over the restriction against prefixal pitch accents. Because of a minimal word requirement banning CV(C) content words (see section 3.2), this situation is limited to underlyingly disyllabic roots of the form /aCV/, which lose the initial /a/ when certain pronomimal prefixes are added, as in (28b) (see Munro and Willmond 1994 for discussion of /a/ syncope).

(28) a. (kaˈtaːt) ˌ**tʃim{ˈpí̍ˌsa}**? ‘Who looks at him for you?’
(kaˌtiːˌmihˈtãː) **iʃ{ˈhíˌla}** ‘Why are you dancing?’
(kaˈtaːt) ˌ**põː{ˈhíˌka}**? ‘Who is standing for us?’
(kaˈtaːt) ˌ**aː{ˈhóˌjo}**? ‘Who is looking over there?’
(kaˈtaːt) **iˌliː{ˈpíˌsa}**? ‘Who looks at herself/himself?’
(kaˌtahˈtãː) **hoo{ˈáˌbi}m**? ‘Who did they kill?’
b. (ˌnanˌtahˈtãː) **ˈíʃ{ˌpa}m** (underlyingly /iʃ-apam/) ‘What did you eat?’
(kaˌtiːˌmihˈtãː) **ˈháʃ{ˌla}** (underlyingly /haʃ-ala/) ‘Why are you (pl.) here?’

The restriction against the pitch accent docking on a prefix is similar to the confinement of stress to roots in many languages. In fact, the asymmetry between prefixes, which resist the pitch accent, and suffixes, which do not, in Chickasaw (see section 5.2), has analogs in certain stress systems, in which prefixes and suffixes behave differently. For example, in Cahuilla (Seiler 1957, 1965, 1977), suffixes and roots form a stress domain to the exclusion of prefixes, which constitute their own stress domain. Unlike in languages with morphologically-sensitive stress, however, the Chickasaw restriction on prefixal pitch accents does not reflect a general restriction against stress falling to the left of the root, since IP-non-final words can have primary stress on a prefixal CVV syllable, as predicted by the general stress rules of the language (see section 2.1), e.g. ˈaː{hiˌkaʔ} ‘stopping place’ with primary stress on the locative prefix aː-.

As argued in section 2.1, there is independent evidence from rhythmic stress and lengthening that many prefixes, including those that reject the pitch accent, belong to a different prosodic word from the root. A prosodic boundary also separates members of a compound, a fact which accords with the realization of the pitch accent on a syllable within the rightmost root even if this entails placing a pitch accent on a CV penult: (ˌnanˈtaːt) {aˌkank}{ˈóˌʃiʔ} '(What is) a chick?' (akankaʔ 'chicken' + oʃiʔ 'baby'), (ˌnanˈtaːt) {aˌkank}{ˌoʃ}{ˈáˌpaʔ} '(What is) a chicken snake?', (akankaʔ 'chicken' + oʃiʔ 'baby' + apaʔ 'eater'), (ˌnanˈtaːt) {baˌlaːfˌkaʔ}{ˈtóˌbaʔ} '(What is) denim?' (balaːfkaʔ 'pants' + tobaʔ 'step relation').

The requirement that the pitch accent fall within the same prosodic word as the root is captured by the alignment constraint requiring that the head word of an IP carry a pitch accent, ALIGN (HDWD$_{IP}$, T*). Minor phrases consisting of multiple prosodic words diagnose new rankings of ALIGN (HDWD$_{IP}$, T*) relative to certain stress constraints. Words ending in a heavy syllable (CVV, CVC) prefix belonging to a different prosodic word from a following disyllabic root of the form CVCV(C) place the pitch accent and thus primary stress on the initial light syllable of the root, i.e. ˌCVX {ˈCV́ˌCV}. This creates a stress clash not present in words of a comparable shape –CVXCVCV but consisting of a single prosodic word; in such words, the antepenult carries the pitch accent and primary stress, i.e. –ˈCV́XCVˌCV. ALIGN (HDWD$_{IP}$, T*) is thus ranked above *CLASH as shown in (29).

(29)

(kataːt) tʃim{pisa} L% 'Who looks at her/him for you?'	ALIGH (HDWD$_{IP}$, T*)	*CLASH
☞ ˌtʃim{ˈpíˌsa} L%		**
ˌtʃím{piˌsa} L%	*!	

In addition, ALIGN (HDWD$_{IP}$, T*) is ranked above PK-PROM ($\mu_{[+voc]}\mu_{[+voc]}$), since even a long voweled prefix fails to attract the pitch accent (and thus stress).

(30)

(kataːt) aː{pisa} L% 'Who looks at her/him there?'	ALIGN (HDWD$_{IP}$, T*)	PK-PROM ($\mu_{[+voc]}\mu_{[+voc]}$)
☞ ˌaː{ˈpíˌsa} L%		*
ˈáː{piˌsa} L%	*!	

At the same time, however, *CROWD and TBU $\mu_{[+vocalic]}$ are ranked above ALIGN (HDWD$_{IP}$, T*), since a root which is CV due to the loss of its initial vowel passes the pitch accent to a prefix: (nantahtãː) ˈíʃ{pa}m 'What did you eat?' (underlying /iʃ{apa}m/).

5.2 Suffixes

Suffixes have the opposite effect of prefixes on the pitch accent: rather than resisting the pitch accent, they attract it, even if purely phonological conditions would predict that the pitch accent would fall on the root. Thus, in a word containing at least one suffix, the pitch accent falls on a syllable containing a vowel belonging to a suffix. If, however, the only suffix is a final syllable containing a short vowel, it does not carry the pitch accent, reflecting the overriding restriction against tonal crowding on CV(C) final syllables. In case there are multiple non-final suffixal syllables, the rightmost non-final syllable, i.e. the penult, attracts the pitch accent.

Because of the ban on final CV(C) carrying the pitch accent, the interesting cases in which the special ability of suffixes to carry the pitch accent manifests itself are limited to those in which the penult is a suffix of the form CV. In practice, two factors conspire to limit the pool of suffixes that are probative in evaluating the behavior of suffixes with respect to pitch accents. First, most suffixes of the requisite phonological shape are semantically incompatible with questions. Second, certain syncope processes conspire to eliminate CV syllables where they could potentially demonstrate the special ability of suffixes to attract the pitch accent (see Munro and Willmond 1994:xxxv-xxxvii). There are, however, certain suffixes which are semantically compatible with questions and which surface with a short vowel in an open penult, such as the first person singular subject suffix –li, the causative suffix –tʃi, and the future/incompletive suffix –aʔtʃi. When they attract the pitch accent, the vowels in these suffixes, all of which underlyingly contain short vowels, lengthen by a process of pitch accentual lengthening, as in (31a). The examples in (31b) demonstrate that the same suffixal vowels in final position do not attract the pitch accent due to the ban on tonal crowding on final CV(C).

(31) a. {piˌsaː}ˈ**lǐː**ˌtam? 'Was I looking at it?' (underlyingly /pisa**li**tam/)
{tʃoˌfaːt}ˌ**aʔ**ˈ**tʃǐː**ˌta? 'Will s/he be clean?' (underlyingly /tʃofata**ʔtʃi**ta/)
{jimm}ˌ**aʔ**ˈ**tʃǐː**ˌta? 'Will s/he believe it?' (underlying /jimmi**aʔtʃi**ta/)
{aˌpiːla}ˌ**tʃiː**ˈ**lǐː**ˌtam? 'Did I have her/him help her/him?' (underlying /apila**tʃili**tam/)
{piˌsaː}ˈ**tʃǐː**ˌta? 'Does s/he have her/him look at her/him? (underlying /pisa**tʃi**ta/)
{hiˌɬaː}ˈ**lǐː**ˌta? 'Am I dancing?' (underlying /hiɬa**li**ta/)
b. (kaˌtiːˌmihˈtãː) {hiˈɬáː}ˌ**li**? 'Why am I dancing?'
(kaˌtahˈtãː) {piˈsaː}ˌ**li**? 'Who am I looking at?'
(kaˌtiːˌmihˈtãː) {hiˈɬá}**ʔ**ˌ**tʃi**? 'Why will s/he dance?'

Unlike in the case of the prefix-root boundary, there is no independent evidence for a prosodic word boundary separating the root from suffixes that attract the pitch accent. For example, the suffix –li which attracts the pitch accent when non-final in questions (see 31a), receives stress and undergoes rhythmic lengthening following a CV syllable belonging to the root; e.g. tʃiˌ{piːsa}ˌ**li**ːˈtók 'I looked at you' (underlyingly /tʃipisa**li**tok/). If the suffix –li did not belong to the same prosodic word as the root we would not expect it to receive stress and undergo rhythmic lengthening. Rather we would predict a stress on the final syllable of the root, i.e. *tʃi{ˌpiːˌsa}liˈtok, parallel to the stress on the prefix tʃim- following the locative prefix aː- in ˌaːˌtʃim{aˈpiːlaˌtok} 'S/he helps her/him for you there.' [31]

The forms in (31) diagnose a number of new constraint rankings. First, the attraction of the pitch accent by suffixes indicates the effects of a highly ranked constraint requiring that suffixes carry a pitch accent. The attraction of the pitch accent by suffixes in Chickasaw parallels similar effects seen in certain morphological stress systems, e.g. Russian (Halle 1973, Melvold 1990), in which a lexically accented root loses its accent when a lexically accented suffix is added. The Chickasaw suffixal pitch accents differ, however, from these cases in two respects. First, a pitch accent rather than stress is involved. Indeed, stress is clearly not the relevant factor in Chickasaw, since stress at the word-level ignores the boundary between the stem and suffixes (as shown in section 2.1). A second difference between Chickasaw and languages with

[31] There are a few suffixes that are extraprosodic with respect to pitch accent placement. These suffixes are also ignored in the calculation of stress and rhythmic lengthening, suggesting that they are prosodically unparsed.

morphological stress on certain suffixes is that there is no reason to assume that a pitch accent is lexically associated with the suffixes shown to attract stress in (31a).[32]

Because the pitch accent prefers to fall as far to the right edge of the suffix string as possible, a simple constraint banning pitch accents on a root syllable is unable to account for the facts. In his analysis of Russian stress, Alderete (1999:70) proposes an Alignment constraint requiring that the left edge of a stressed syllable be aligned with the right edge of a stem. This constraint, which he abbreviates Post-Stem-Prom (PSP), requires that a stressed syllable fall to the right of the stem and captures the attraction of stress by the suffixal syllable immediately following an unaccented root in Russian. A similar constraint is relevant for Chickasaw, except, in Chickasaw, stress prefers to fall as close as possible to the end rather than the beginning of the suffix string. The highly ranked constraint in Chickasaw thus requires alignment of the right edge of the pitch accented syllable with the right edge of the suffix sequence (32).

(32) ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R): The right edge of a pitch accented syllable must coincide with the right edge of the suffix string.

Following Alderete, this constraint is evaluated gradiently such that more violations are incurred the farther the pitch accent is from the right edge of the string of suffixes. Thus, the candidate {tʃoˌfaːˌt}**aʔˈtʃíː**ˌta 'Will s/he be clean?' with a pitch accent on the penult suffers fewer violations of ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R) than another candidate with the pitch accent on the antepenult. The best candidate in terms of satisfaction of ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R) is one with stress on the final syllable of the suffixal string. However, a pitch accented ultima is precluded in words in which the final syllable contains a short vowel due to the ranking of ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R) below the tonal constraints *CROWD and TBU $\mu_{[+\text{vocalic}]}$: (katahtãː) {piˈsáː}ˌ**lim** 'Who was I looking at?'. Nor may a final short suffixal vowel undergo lengthening in order to honor ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R). This indicates that WEAKEDGE outranks ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R).

ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R) is, however, ranked above both *CLASH and ALIGN (σ́, R, PrWd), as positioning the pitch accent on an underlying CV penult leads to a stress clash with the preceding heavy antepenult and an additional stress not at the right edge of the word (33).

(33)

{jimmi}**aʔtʃi**ta ''Will s/he believe it?'	ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R)	*CLASH	ALIGN (σ́, R, PrWd)
☞ {ˌjimm}ˌ**aʔˈtʃíː**ˌta [33]	*	***	* ** ***
{ˌjimm}ˈ**áʔtʃi**ˌta	**!	*	** ***

The ranking of ALIGN (H*, R, $\{\ldots\}_{\text{suffix}}$, R) above *CLASH may be contrasted with the ranking of the more generic ALIGN (T*, R, IP) below *CLASH, since words underlyingly with a heavy antepenult followed by a light penult both of which belong to the *root*, place the pitch accent on the antepenult in order to avoid a stress clash, {ˈmálli}ˌta 'Does s/he jump?'.

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[32] I am aware of only one suffix that contains a lexical accent, -íʃa 'yet' (Munro and Willmond 1994:1). It is unlike the suffixes discussed in the text since it is accented even in statements where it would not be expected to be.

[33] Hiatus arising from addition of the future suffix –aʔtʃi is resolved by deleting the root-final /i/.

An interesting aspect of suffixal pitch accent placement is that an underlying CV suffix with a pitch accent is lengthened. Short root vowels carrying the pitch accent do not lengthen in order to ensure that SWP is satisfied, however, as the examples of prefixed words in (28a) showed. We thus have an example of a positional faithfulness constraint (Beckman 1997) at work. Faithfulness in the first syllable of the prosodic word, DEP-IO$_{PrWd[\sigma}$ (μ) outranks the general faithfulness constraint, DEP-IO (μ), in keeping with the cross-linguistic bias toward faithfulness in initial position (see Beckman 1997). Sandwiched in between these two faithfulness constraints is the well-formedness constraint SWP. Crucially, the positional faithfulness constraint must refer to the first syllable of the prosodic word and not the root, as underlying short vowels which belong to the root but which are not in the first syllable of the minor prosodic word lengthen in strong position as part of the rhythmic lengthening process (section 2).

5.3 Interactions between morphology and prosody

The influence of morphology on pitch accent placement in Chickasaw is an unexpected dimension given the typical blindness cross-linguistically of morphology to intonational phenomena such as pitch accent placement. Because intonation is a phrasal process applying, in derivational terms, postlexically, it is not expected to have access to morphological bracketing, which should already be invisible by the time postlexical phonology applies (Pesetsky 1979, Kiparsky 1982). Chickasaw is not alone, however, in displaying a phrase-level phenomenon that has access to morphological information. Halpern (1992) discusses the case of the English possessive suffix ’s whose distribution is phrasal (attaching to the right edge of a possessive NP) but which nevertheless undergoes a morphologically-sensitive process of deletion. It asymmetrically deletes after regular sibilant plural suffix but not after singular nouns ending in a sibilant or after irregular plurals ending in a sibilant: the books’ covers [bʊks/*bʊksəz] vs. the cheese’s aroma [tʃizəz/*tʃiz] and mice’s tails [maɪsəz/*maɪs]. Hargus (1988) addresses apparent violations of bracketing erasure in her discussion of the phonology of the Sekani verb. For example, certain processes (e.g. voicing assimilation and s-voicing) require direct reference to the stem, since they are potentially triggered by prefixes that are not themselves targets. Kidima (1990) also discusses a postlexical rule of high tone shift in Kiyaka that crucially applies across morpheme boundaries within a clitic group but not within morphemes. All of these processes have in common that they apply within relatively large prosodic domains but must reference morphological categories predicted to be transparent to phrasal phonology (see also Hayes 1990 on phonological phenomena referring to morphosyntactic information).

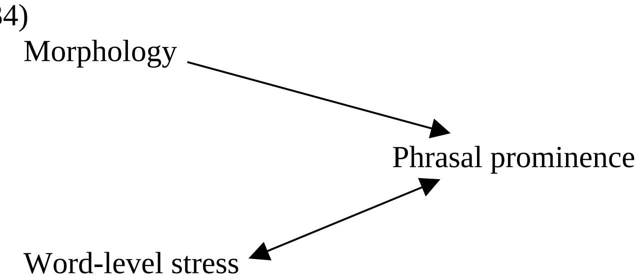
Unlike cases of bracketing erasure violations that are amenable to reanalysis in terms of independently motivated constituents (see, for example, Halpern 1992 for a reanalysis of the Sekani data), there is no independent evidence in Chickasaw that suffixes form a constituent to the exclusion of roots. As discussed in section 2.1, the same suffixes that attract the pitch accent away from roots belong to the same rhythmic lengthening domain as the root. Furthermore, there are no other phenomena that would independently argue for suffixes forming a constituent distinct from roots. Nor can suffixes be easily united into a single morphosyntactic category, such as the head of a phrase, which could be referenced by pitch accent placement. Chickasaw thus differs from Kimatuumbi, in which certain phonological processes refer to the stem, where the stem could be analyzed, following Odden (1987), as a syntactic head.

Even if suffixes could be argued to form a separate phonological or syntactic constituent distinct from the root, it would not be possible to adopt a single cyclic rule of pitch accent placement applying first within the suffixal domain and then within the root, since the principles governing pitch accents differ between the two domains. Whereas clash avoidance forces the pitch accent onto a heavy (CVV or CVC) antepenult from a light penult in the root, a light suffixal penult attracts stress even though this creates a stress clash with the antepenult, which must be either inherently heavy or heavy by rhythmic lengthening. This difference between pitch accent placement within roots and suffixes is illustrated by the following pair of words that is phonologically identical but morphologically different over the last three syllables: {ˈtʃíːli}ˌtam ‘Did she lay eggs?’ vs. {aˌpiːla}ˌtʃiːˈlíːˌtam (underlying /{apila}tʃilitam/) ‘Did I have her/him help her/him?. In the former word, the light penult in the root passes the pitch accent leftward to the antepenult, while, in the latter word, the light suffixal penult keeps the pitch accent and lengthens. This asymmetry indicates that there is no single unified process of pitch accent placement applying first within the suffixal portion of a word and then within the root. Rather, the rightward pitch accent alignment effect is stronger in suffixes than in roots, though the overriding constraint against tonal crowding on final syllables overrides rightward alignment even in suffixes.

6 Conclusions

Prominence in Chickasaw displays a number of asymmetries between words in phrase-final position and words in non-final position of a phrase, asymmetries that are effectively modeled in Optimality Theory using interleaved phrase-level and word-level constraints. In certain cases, phrase-level pitch accent constraints (e.g. a pitch accent alignment constraint, anti-tonal crowding constraints) outrank word-level stress constraints, thereby yielding “top-down” assignment of stress to syllables carrying a pitch accent. Alongside top-down stress, “bottom-up” pitch accent placement arises when a word-level anti-clash constraint takes priority over a rightward pitch accent alignment constraint. Still another asymmetry between word-level and phrase-level prominence involves morphology, which is relevant for pitch accent placement but not for word-level stress placement. The relationship between phrase-level prominence, word-level stress and morphology which ultimately emerges in Chickasaw is summarized in (34), where arrows indicates directionality of influence in the relationship.

(34)



Although the relationship between morphology, phrasal pitch accents, and word-level stress is unique to Chickasaw in many ways, certain aspects of the Chickasaw prominence system are found in other languages. The Chickasaw asymmetry between word-level and phrase-level prominence has analogs in other languages in which final stress avoidance is more stringent at the phrase-level than at the word-level. The intonational analysis of phrase-level non-finality effects adopted for Chickasaw thus extends to these languages with minor modifications.

Similarly, morphological stress is attested in many languages, although the Chickasaw prominence system is unusual in showing sensitivity to morphology only at the phrase-level.

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